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Essay on Earthenware and Porcelain.

[From Parkes' Chemical Essays.]

In attempting the history of the manufacture of European porcelain, it may be remarked, that although porcelain had been brought into this quarter of the world before Christ, there is reason to believe that the introduction of the knowledge of making porcelain in Europe was but of late years, as will be seen in the sequel. Porcelain is not made even now in the Indies; what is consumed there is all imported either from Persia, Japan, or China, and the other kingdoms between China and Pegu.

The English, cannot, I presume, lay claim to much excellence in their manufacture of earthenware, before the time of the late Mr. Wedgwood, who began his indefatigable researches about the year 1750: for, in the beginning of the last century, all the best tiles, and even the finer sort of bricks, were imported from Denmark, Germany, and Holland. Not but that bricks and tiles of clay had long been made amongst us; for there is an act of parliament now on the statute books, that was passed in the reign of Edward IV. which directs the time for digging the earth, the manner of making the bricks, &c.; and it is so expressed, that we have reason to conclude that bricks had been made in England from time immemorial. While on this article, I am desirous of mentioning, that there is a paper on the process of burning bricks, in the third volume of Bergman's Chemical Essays, and that it contains many hints which may be useful to those who are engaged in that occupation.

It seems strange, that our remote ancestors did not arrive at greater perfection in the manufacture of all these articles, when it is considered that the island produces not only a great variety of clays, but also all the other materials necessary for the production of the best earthenware

and porcelain. Dr. Martin Lister, who wrote in the latter part of the seventeenth century, distinguishes no less than two-and-twenty different sorts of clay in Britain, which fell under his own observation. Moreover, the exquisite pieces of workmanship which were produced at different periods by the English sculptors, show that there was no deficiency of genius and skill among our artists, who probably conceived that the working in clay was beneath their attention.

The common stoneware, and that called white enamel, have been made in various countries of Europe ever since the fifteenth century. The former of these is distinguished by a glaze, made by means of muriate of soda; the latter is covered with a real glass, rendered opaque by the white oxide of tin.* Stoneware is the only article of pottery that can be employed for chemical purposes, where a great heat is required. Macquer says that our best common stoneware is the most perfect pottery that can be, and that it has all the essential qualities of the finest old Japanese porcelain. Mr. Pott, the author of *Lithogeognosia*, has written a treatise expressly to explain the requisite perfections of stoneware, for the purpose of chemical vessels; but I conceive that what is made at Lambeth near London by the best of those manufacturers, is susceptible of but little improvement. For boiling sirops, and for many other culinary purposes, the Lambeth stoneware is the best article that can possibly be employed; as it is cheap, will stand a great heat, and is perfectly wholesome; whereas many of the earthen utensils used in our kitchens, are glazed with lead, and consequently are extremely dangerous. Several years ago, I adverted to this subject in another work; but I was desirous of repeating the admonition now, because I consider the health of the community must be impaired by the frequent use of earthen vessels which are covered with the common Staffordshire glaze. The acetic acid will readily dissolve the oxide of lead; hence the boiling of pickles, and the making of other culinary preparations in such vessels, must be highly improper.

The white enamel ware, was brought to its present state of perfection, by Bernard de Palissy, a native of the diocese of Agen, in the province of Guienne in France; a spot celebrated for being the birth-place of the memorable Joseph Scaliger.†

Palissy was in a low station of life; but he was eminent for his knowledge, industry, and talents. There were indeed so many interesting traits in his character, that I trust, I shall be excused, if I recite a few of the chief circumstances of his history.

He is said to have been a skilful painter upon glass,‡ but he was more generally known as a chemist. Originally, he was a land-sur-

* The oxides of many other metals are used in different branches of pottery, as will be shown in connexion with the latter part of this subject.

† Scaliger is called *memorable*, because he was not only well versed in all the sciences, but understood thirteen different languages. It has been said that he was the most learned man that any age ever produced. The variety of subjects on which he wrote with applause, is truly astonishing.

‡ In the time of Palissy the art of painting upon glass was nearly lost. In this country, it was classed with the ARTES PERDITAE; but Mr. Walpole has

veyor and draughtsman; but his taste for natural history led him to abandon this employment, and induced him to travel for instruction over the whole of France and Lower Germany. An accidental circumstance threw into his hands a cup of enamelled pottery; and, from that time, his whole attention, and fortune, were taken up in experiments on enamels.* Nothing can be more interesting than the narrative which he himself has given of his labours.

He exhibits himself as building and rebuilding his furnaces, always on the eve of success; worn out by labour and misfortune; the derision of the public; the object of the angry remonstrances of his wife; and then as being reduced to such an extremity as to burn his furniture, and even some of the wood-work of his house, to keep his furnaces going. His workman presses him for money, he strips himself and gives him part of his clothes. But at length, by dint of indefatigable labour, constancy, and genius, he arrived at the desired degree of perfection, which gained him the esteem and consideration of the greatest men of his age.

He was the first who formed a collection of natural history at Paris. He even gave lectures on that science, and received a moderate subscription from each of his auditors, under the obligation of returning it four-fold if any thing he taught should prove false. He was the author of many singular books on subjects of agriculture, fire, earth, salts, &c. that are now very difficult to be found, and it is to him especially, that Buffon is indebted for many useful hints.

Palissy was the first who ventured, in the face of the priests, to affirm that fossil shells and calcareous mountains are the remains of real shells; he was also the first who taught the true theory of springs, and was in all respects an eminent and accomplished man. The very form of his works, exhibits a proof of original genius; they consist of dialogues between Theory and Practice, in which Practice is always the instructer, while Theory is represented as a scholar, proud of his own understanding, but indocile and ignorant.

The high reputation he acquired, and the obligations under which his countrymen stood indebted to him, were however not sufficient to defend him from the persecution of the League, for, being a protestant; Matthew de Launay,† one of the greatest fanatics of his day, caused him to be dragged to the Bastile at the age of ninety years, where he signalized himself by acts of firmness and heroism.

His reply to Henry III. deserves to be commemorated. "My good man," says the King, "if you cannot reconcile yourself to the matter of religion, I shall be compelled to leave you in the hands of my enemies." "Sire," said Palissy, "I was perfectly ready to sur-

shown, by a regular series of artists and their performances, that this secret was never entirely lost. Walpole's *Anecdotes of Painting.*

* The modern enamel painting, is quite a different art. This was invented by John Petitot of Geneva. An account of his experiments and discoveries may be seen in the Biographical Dictionary, article *Petitot*, and also in Grainger's Biographical History, vol. ii. p. 288.

† This man must not be confounded with the celebrated De Launay who wrote "Remarks on the Roman Jurisprudence," and died in 1693.

render my life; and if the action could have been accompanied with any regret, certainly it must have vanished, after hearing the great King of France say, 'I am compelled.' This, sire, is a situation to which neither yourself, nor those who force you to act contrary to your own disposition, can ever reduce me, because I am prepared for death; and because, neither your majesty, nor your whole people, have the power to compel a simple potter to bend his knee before the images which he fabricates." This venerable man died about the year 1590.

Several of the nations of Europe, at the dawn of the eighteenth century, could not but regret that the knowledge of the manufacture of porcelain had not been introduced among them. At this time, however, a fortunate circumstance aroused the attention of the French people, and directed it to this important subject.

Francis D'Entrecolles, who had resided many years in China as a Christian missionary, a man of insinuating manners, and of a mild and affable deportment, had the address to procure specimens of the materials used by the natives, in their porcelain, and these he sent to France, with a summary description of the Chinese processes.

It may appear strange that so jealous a people as the Chinese are known to be, should have allowed of European missionaries being settled among them. The ecclesiastical historian Mosheim, has, however, investigated this subject, and it is highly amusing to read his account of the arts which the Jesuits practised, to interweave the doctrines of Jesus, with those of Confucius, and to learn how they ingratiated themselves with the inhabitants of that country.

When the specimens arrived in France, the celebrated Reaumur undertook a series of experiments to discover the method of imitating the Chinese productions; and he persevered with amazing industry, until he had obtained the main object he had in view.

The difficulties which he had to encounter; the mistakes he made during the investigation; the cause of those mistakes, and the extent of his success, are all well detailed in the French Dictionary of Chemistry, translated by Mr. Keir, and will be found under the article Porcelain. Mr. Reaumur himself, in the years 1727 and 1729, also published a full account of his progress in this inquiry, in two memoirs addressed to the Academy of Sciences, and which were printed in their Transactions.

While Reaumur was engaged in these experiments, porcelain was begun to be manufactured in Saxony, and soon afterwards other manufactories of it started up in different parts of Germany. We had also an establishment for making it at Chelsea; and since that period various companies in different parts of England, France, and Italy, have been founded for the same purpose.

The first person who made porcelain for sale in Saxony, was the Baron Botgar, and it is probable that his was the first manufactory of real porcelain in Europe. In order as much as possible to preserve this art as a secret, the works were rendered impenetrable to any but those who were immediately employed in them.

M. De la Condamine, in his journey into Italy, visited a manu-

factory of porcelain established at Florence by the Marquis de Ginori, governor of Leghorn, where he saw statues and groups half as large as nature, and modelled from some of the finest antiques. He describes the body of the ware as being equal to the best Chinese manufacture, and that it would be extremely beautiful if it had a whiter glazing; but that the Marquis was determined to use only such materials as were found in his own country. How superior are the advantages which the English nobility possess for improving the manufactures of these kingdoms, if it were thought becoming in them to attend to such objects! In France, the Count de Lauraguais engaged in the pursuit of improvements in porcelain for several years with uncommon ardour and success. [*French Chemical Dictionary.*

The establishments of the most consequence among the moderns are, one at Dresden; the King of Prussia's own manufactory at Berlin; and the extensive works which belonged to the late King of France at Sevres, near Paris. There is also a considerable establishment for the manufacture of porcelain at Montpelier; a descriptive account of which, together with the process for making the peculiar glaze which is employed there, was published some years ago in the *Annales de Chimie.*

Frederick the Second, King of Prussia, had conceived so high an opinion of the importance of the manufactory at Dresden, that when he conquered Saxony he took many of the best workmen away by force, and transported them to his own pottery at Berlin. This manufactory at Berlin since the year 1763 has been carried on for his majesty's own private account, with success and with good taste. Five hundred men have constant employment in it, and large quantities of the porcelain are annually exported.

Mr. Jonas Hanway, in the account of his travels, has published a particular detail of an immense collection of porcelain which is laid up in the Chinese palace at Dresden. The whole recital would be unsuitable to these essays; but the following particulars will show how the Elector of Saxony valued himself on account of the perfection to which the manufacture of porcelain had arrived in his dominions.*

"The vaults of this palace," says he, "consist of fourteen apartments filled with Chinese and Dresden porcelain. One would imagine there was sufficient to stock a whole country; and yet they say, with an air of importance, that a hundred thousand pieces more are wanted to complete the intention of furnishing this single palace."

"Here are a great number of porcelain figures of wolves, bears, leopards, &c., some of them as big as the life; a prodigious variety of birds, and a curious collection of different flowers. A clock is preparing for the gallery, whose bells are to be also of porcelain: I heard one of them proved, and sufficient to form any music; but the hammers must be of wood."

* The potters of Dresden were always as curious in the management of their ovens as they are in the manufacture of their porcelain. Nothing but white wood is employed for heating the kilns, and this is never used till it is become thoroughly dry.

"Here are forty-eight large China vases, which appear to be of no use, nor any way extraordinary, except for their great size; and yet his Polish majesty, purchased them of the late King of Prussia, at the price of a whole regiment of dragoons."

In the course of the narrative, Mr. Hanway mentions one very interesting circumstance, viz. that samples of the *first efforts* to make china in Saxony, were laid up by the King of Poland in this palace, together with specimens of all the improvements, in their several gradations, from the first, till the time when the manufactory arrived at its utmost state of perfection;* an idea truly philosophical, and which reflects more honour on his memory, than the bartering away the liberties of his subjects, for pieces of foreign porcelain.

The passion for collecting porcelain, has been common in most countries. Dr. Campbell remarks that "to Ormus, at the proper season of the year, resorted the merchants from Persia, Arabia, and Turkey. At these seasons," he says, "the city wore a new face, the outsides of the houses were adorned with cabinets of porcelain, and with beautiful paintings; and all the riches of the East blazed in the eyes of the captivated spectator."

The greatest part of the earthenware that is now made in England is manufactured in a particular district of about ten miles extent, well known by the name of the Staffordshire Potteries. Here earthenware has probably been made ever since the time of the Romans,† but there did not appear to have been any ambition among the manufacturers to improve the art, or to produce any works of taste, till the late Mr. Wedgwood engaged in the business. This most excellent man brought modellers from Italy and from other parts of the continent, whom he engaged at high wages; and he also constantly employed a competent chemist in experiments, that nothing might be wanting which could conduce to extend the employment of earthenware throughout Europe, or that could in any way tend to give a permanency to the staple manufactory of the county which had given him birth.

Amidst a collection of the most beautiful medallions of British and Foreign Worthies, the manufactory at Etruria produces vases and urns in imitation of jasper and other variegated stones; a fine black porcelain, of which very beautiful vases and bas-reliefs are made, after antique patterns; Etruscan vases ornamented with encaustic paintings, after the antique; and bas-reliefs of a white composition, on coloured grounds, so as to have the effect of enlarged cameos. To the late Mr. Wedgwood the country is indebted for all these discoveries in the art of pottery.

Notwithstanding the energy with which Mr. Wedgwood devoted

* The potters in Saxony are so exact in the management of their manufactories, that they employ none but the purest rain-water for soaking the clay; and they prepare the clay only twice a year, at the equinoxes; conceiving that at those seasons, the water is less contaminated with foreign ingredients.

† In sinking pits, very evident remains of Roman potteries have been discovered, and at a considerable depth below the present surface of the land.

his inventive talents and chemical knowledge, to the improvement of his favourite manufacture, during the course of a long and industrious life, I have no doubt that chemistry might still confer many benefits on the potter's art, if the manufacturers in general would bestow such an education upon their children as would enable them to pay a proper attention to the cultivation of this science.

Impressed with this idea, I have myself frequently inspected several of the largest manufactories of earthenware in this kingdom, as well as many others of inferior note, and have examined their various processes with the utmost care and attention. A residence of several years at Stoke-upon-Trent, in the midst of the Staffordshire potteries, afforded me the best opportunities for this purpose, and enabled me to make those inquiries at my leisure, and to acquire that information, which none but an inhabitant could easily have obtained.

It will not, however, be necessary for me, while giving an account of this manufactory as at present conducted, to go much into detail; because, if this were the object I had in view, it would be necessary to devote a volume or more to the purpose; for I am acquainted with few manufactories in which the operations are more numerous and diversified.

On this account, I shall content myself with giving such an outline of the business as will afford the general reader a correct idea of the nature of the different operations; and at the same time shall propose, for the consideration of the manufacturers themselves, such hints for the improvement of some of the processes, as I conceive to be worth their attention.

[TO BE CONTINUED.]

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*Description of the Mode of Manufacturing Starch, in France.**

THE starch of wheat, rye, barley, &c., being prepared by the same method, we shall treat of these grains without distinction, either as to their being used singly, or mixed in various proportions. The manufacturers prefer that grain which has been injured by remaining long in damp warehouses, and rendered improper for most other purposes; not only because it is cheaper, but because the starch, being less alterable than most other immediate products from vegetables, is still obtained in great abundance, with more facility, and often even in nearly an equal quantity, as from uninjured grain.

They commence the operation by coarsely grinding the grain; which is effected in the ordinary mills by raising the upper mill-stone, by which means the space between the two stones is augmented, and the grain passes through, merely bruised. If the grain employed be too wet, it sticks between the stones, from which it is with difficulty disengaged, and more power is required to obtain even this small quantity; but this inconvenience is avoided by a previous desiccation. After this first preparation, they steep the grain, thus bruised, in

* From the Dictionnaire Technologique.

large tubs half filled with water, to which they add an eighth, or a tenth, part of the *sour water*, remaining from a former operation: by degrees fermentation takes place, and proceeds with a rapidity in proportion as the grain employed contains a greater quantity of gluten, or as the temperature of the atmosphere is more elevated. When fermentation has commenced, the liquor becomes viscous, acquires a degree of acidity, and at length is covered with a thickish crust of mould. In this state they term it *sour water:** this water is drawn off by means of a cock, placed at the height which the deposit occupies in the tub; or by means of a portable syphon, which serves for many tubs: but, previously, they take off the crust of mould, or *head*, with a skimmer; the greater part of the gluten is decomposed; and the products of this decomposition, with the extractive matter of the grain, are separated by this first decantation: they wash the deposit many times, and afterwards mix it with water, and throw it into a hair or wire-sieve, resting upon two pieces of wood, placed across the top of a vat. They have lately applied to this operation (in order to separate the coarsest bran) a revolving sieve, made in the manner of the Achimedian screw. This instrument is a cylinder, the interior of which is traversed by a continued band of diaphragms, disposed around an axis in the form of a screw; and on these the cloth is retained, in a cylindrical form. The axis of this sieve is made cylindrical at each extremity, and turns upon two proper bearings; it is placed obliquely, so as to form an angle of from 20° to 30° with the horizon: it may either be turned round by means of a winch or handle, in the same manner as the Archimedian screw, used in draining morasses; or by a leather strap and a pulley. The construction of this machine, is exactly the same as that of the elevating screw; only their functions being different, the movement given to them must be in a contrary direction; so that instead of the screw, as usual, raising portions of liquid from below, at intervals quickly succeeding each other, until they are finally discharged at the top of the screw, the machine is, in this case, constantly fed at its highest part, with the mixture formed by the deposit which we have before spoken of. A small stream of water runs upon the exterior of the metallic cloth, and incessantly washes it: the operation is thus carried on in a continued manner; and the bran, or ligneous covering of the grain, escapes at the lower part of the sieve, perfectly free from the starch which it contained. That which has passed either through the revolving sieve of the new machine, or the ordinary sieve of the starch-makers, affords, by repose and decantation, a *sour water*, which is employed in the same manner as that we have before described. The deposit however, contains, besides starch, a quantity of very fine bran; to effect the separation of these two substances, it is beaten up with water, and left to settle: the starch precipitates first, and occupies the bottom of the vat; the bran falls next, and forms the upper part of the deposit. They remove the surface until they arrive at the starch, which is

* It is composed, according to M. Vauquelin, of water, acetic acid, acetate of ammonia, phosphate of lime, and gluten.

known by its whiteness and firmness: they rinse the surface of the starch, to free it from those particles of bran which may still adhere to it; they again beat up the white mass, thus rinsed, and pour the whole into a silk sieve, or into a machine similar to the one we have above described; but with this difference, that its exterior covering is formed of a cloth closer in its texture, resembling that of a silken sieve. By one, or other, of these means, they separate an additional quantity of fine bran, and the starch which passes is whiter, and purer: nevertheless, it must be again beaten up with water, suffered to repose, the supernatant water decanted, and the surface of the deposit be again rinsed, which is still a little soiled by the finest particles of bran. The starch is now very white: in general, however, its whiteness, and purity, depend upon the precautions which have been taken in the many washings, and on the fineness of the last sieve through which it has been passed.

Desiccation.—This operation, although very simple, nevertheless requires many precautions; for the whitest starch, when taken from the last washings, often becomes of a brownish or greenish colour, which requires it to be again mixed with the common starch which is obtained from the rinsings, or from those grains which are the most injured, and which are classed, according to their whiteness, into various qualities. They put the starch, ready to be dried, into square baskets, (whose angles however are rounded off,) each being furnished with a loose cloth. These baskets are generally of the following dimensions: 20 inches long, 14 wide, and 11 high; they fill them as full as possible with starch, and compress it by slight jerks; they leave it awhile to drain, and stiffen; it is then carried to the drying-house. This is a large building, whose upper part is divided into many compartments, surrounded with shutters, and the interior furnished, near its sides, with stages of wooden planks, laid horizontally, at the distance of about 16 inches apart; there is also a level bed of plaster of Paris, formed close to these stages. They deposit the contents of their baskets upon this bed, and remove the cloths, which have quitted the baskets with the moulded blocks of starch.

The starch is thus brought to its first degree of desiccation: they carry it afterwards to the stages, and divide each block into sixteen parts, for the purpose of presenting a greater surface to the drying action of the air: these are very frequently turned, as well to accelerate the desiccation, as to avoid the least mouldiness, or dust, &c. which might soil the starch, and which there is less chance of guarding against, by a longer continuance on the stages: they then carry these pieces to a stove, first taking care to scrape their surfaces slightly; they are then divided into smaller pieces, by the hand, always keeping in view the drying of this substance as quickly as possible; they should be turned, from time to time, with a wooden spatula, to change their surfaces. By these precautions, which it is proper to increase, or diminish, according to the hygrometric state and temperature of the atmosphere, it is certain that the starch will be preserved in its original whiteness.

Knowing the composition of the various grains, of barley, wheat, &c.

we can thus establish the theory of what takes place in the preparation of starch. These grains contain much starch; the ligneous matter, forming the husks of the grain; a small variable quantity of gluten, albumen, and certain salts; amongst others, the phosphate of lime.

The re-action of the gluten upon the starch, occasions the formation of a little saccharine matter; the continued ferment in the mixture, causes the *spirituous fermentation*, and produces alcohol, and carbonic acid. This last is disengaged in the gaseous form, and from thence are derived the bubbles which arise, and burst, at the surface of the liquor. The *acid fermentation* immediately follows; the *sour water* necessarily excites this fermentation, from which results a new quantity of vinegar; and soon after, the gluten, by reason of the large quantity of azote which it contains, and its facility of spontaneous alteration, gives birth to the *putrid fermentation*, which developes ammonia; the gluten and the phosphate of lime are, in part, dissolved in the liquor by the acetic acid, and are partly held in suspension: the re-union of these principles forms the *sour waters* of which we have spoken.

It often happens that the *sour waters*, when they are poured upon the bruised grain, in the first part of the operation, subside, without occasioning any disengagement of carbonic acid gas, any sensible movement, or any other change than making all the liquor thick, gluey, and ropy. This alteration, to which they have given the name of the *viscous fermentation*, although of little importance here, is very remarkable; it is accidentally presented in many other cases, and particularly in the treatment of saccharine matters, where it is almost always injurious, and often occasions considerable loss.

Uses.—Starch is employed in many of the arts, although but in small quantities: painters, confectioners, laundresses, &c. make great use of it; physicians prescribe it as an aliment of a peculiar nature, and as a medicine; but in this case, as also in the manufacture of sugar from starch, they give the preference to the starch, or fecula, of the potato.

Composition.—Starch is formed in weight, according to M. Berzelius, of

Carbon	43,481
Oxygen	49,455
Hydrogen	7,064
	100. P.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c., London.

No. III.—CHEMICAL AGENTS USED IN BLEACHING.

SECTION VII. *Continued.*

4.—*Mr. Tennant's Bleaching Salt, or the Oxymuriate of Lime.*

LIME was impregnated with chlorine, for the purposes of bleaching, at an early stage of the improvements we are now detailing, by

Watt, Henry, and Cooper; but it does not appear that it was by them brought into their general practice, as they seem to have preferred the simple water, or the oxymuriate of potash.* It was reserved for Mr. Charles Tennant of Glasgow, to improve the process of making it so as to render it both a cheap, convenient, and efficacious agent in bleaching.* The first process which he adopted for this purpose, has been already given. (Page 338, Vol. II.) He was deprived of the patent he had for the manufacturing of this substance, in consequence of a legal decision in the Court of Session. The loss of his patent stimulated Mr. Tennant to new efforts of ingenious invention, and he succeeded in combining chlorine with lime, in the dry way, which renders it easily portable to any distance at a small expense.† In consequence of this, his business has increased to a prodigious amount, while the bleaching processes have received great improvement. The expense also, is greatly lessened, as lime is so much cheaper than the alkalies which used to be consumed for this purpose, to a very great amount.‡ *

The concrete oxymuriate of lime, or Tennant's salt, as it is called by the bleachers, is, when prepared for immediate use, diffused by agitation in a quantity of water. This is allowed to stand for some time, till any insoluble matter contained in the lime, is precipitated, and the supernatant liquor remains transparent. The liquor thus clarified, is drawn off and diluted with a considerable proportion of water, when it is ready for the immersion of goods. This salt differs so remarkably from most others, that it cannot be procured from the solution, either in a dry mass, or in crystals, by evaporation; for when such a solution is evaporated, part of the acid escapes, and the rest is mostly converted into muriatic acid; so that, instead of oxymuriate of lime, muriate of lime is obtained. The dry salt can only be obtained by Mr. Tennant's process of using dry lime, in the first instance.

5.—Tests for ascertaining the strength of Oxymuriate of Lime.

In treating of the other agents of bleaching, we have seen of how

* The oxymuriates of barytes and strontites, which were also mentioned in his patent, were found to be too expensive for practical purposes, as the latter substance could not be procured in great quantity, and the former could with difficulty be separated from the sulphuric acid with which it is usually found combined.

† So great is the reduction of expense from this cause, that it was proved upon oath, that, by using oxymuriate of lime, the consumption of ashes, in a single bleaching-green, has been reduced £3000 in value in one year.

‡ In order to produce this important agent, the chlorine gas is sent into a receiver, similar to that formerly described, which contains, in a pulverized form, the dry hydrate of lime; that is, lime slacked with the least possible quantity of water. The powder, during the influx of the gas from the distilling apparatus, is continually agitated, and the gas combines with it to a certain amount, or till the hydrate becomes saturated. The salt so formed, is a soft white powder, which possesses little of that intolerable smell so conspicuous in the gas. It is partially soluble in water, and its solution is little different from that obtained by the process in which the combination is formed in the solution of lime in water.

much importance it is to the manufacturer, to be able to ascertain the quantity of efficient matter, in any of the substances of commerce, which he has occasion to purchase. With respect to oxymuriate of lime, this ought, perhaps, to be still more attended to, insomuch as it is the principal agent for producing pure whites. But I am much mistaken, if any method has come into general use among bleachers, by which the quality of a given quantity of this substance can be ascertained.—They are under the necessity, indeed, of ascertaining the bleaching power of the diluted liquid, previous to immersing their goods, which is commonly done by an indigo test, and in this way, by observing the quantity of salt and the proportions of water used, they may make a rude guess, concerning the strength of the salt, when purchased; but this, at best, must be an inaccurate method of proceeding. To remedy those inconveniences, the ingenious Mr. Dalton instituted a course of experiments, in which he was successful in obtaining a test of easy application, for ascertaining the purity of oxymuriate of lime.

From these experiments it appears, that the green sulphate of iron is by far the best test of oxymuriate of lime. As the indigo test does very well in ascertaining the strength of the diluted liquor, and as it is very generally used, I cannot well omit detailing the manner of its application. Prepare a very dilute solution of indigo by dissolving, in the usual way, a pound of the best Spanish in four pounds of concentrated sulphuric acid, which proportions will generally be sufficient to produce saturation. When all the indigo is dissolved, one part, by measure, of this solution, is to be diluted with sixteen parts, by measure, of water, when it will be fit for use. To obviate any deception which may arise from the difference of strength in the indigo, it is best always to preserve some of a former preparation, to compare with the new, when, by a little management, it may be made equal. The quantity of water used is not material, provided that the same bleacher keep always to the same proportion. The strength of the bleaching liquor, is determined by the quantity of it, which is required to destroy the colour of any given portion of the test. In practice, it is usual to have two graduated glass tubes, one for the test, the other for the liquor, by which arrangement the efficient quantities are seen by inspection. Berthollet says he was informed by Mr. Watt, that the indigo test will not accurately show the strength of either oxymuriate of soda, or of potash, and recommends a decoction of cochineal, as not being so liable to inaccuracy, or deception. From what I can learn, however, this has not been found so convenient in practice, as the indigo test. Mr. Dalton's test from sulphate of iron, will soon, I imagine, supersede all others.

No. IV.—CHEMICAL AND PHYSICAL NATURE OF STUFFS.

No satisfactory account can ever be given of a chemical process, unless all the substances which are employed in it be minutely known, both as to their general nature, and, if possible, as to their

composition when they are compounded.* This has not been properly attended to in any of the works on bleaching which have fallen into my hands, as none of them give any chemical account of the substances which are to be operated upon. This deficiency I shall attempt to supply, although I feel that my information is inadequate to do it justice, and in order to render it more perfect, it would require more laborious analytical and experimental research, than either my ability or leisure will allow. I have derived the best part of the knowledge I have of this subject from Home, Fourcroy, Kirwan, and Bancroft.

Animal substances differ very much from vegetable, both in their physical structure and chemical composition. Wool and silk, for example, are much looser in their texture, and have less adhesion between their constituent parts, than cotton and linen, and are therefore more disposed to combine with other matters which are brought into contact with them, and manifest stronger affinities for the ordinary agents of bleaching.† Their chemical composition is still more dissimilar from that of vegetables, in containing a greater proportion of hydrogen, and particularly of nitrogen, which, in vegetables, is usually present in but small quantity. It is the tendency of these to assume the gaseous form, which renders the adhesion of the ultimate principles in silk, and wool, so slight, and easily overcome. When they are subjected to distillation, these two principles seem to unite, and form with oxygen the volatile alkali, which is seldom developed in any quantity from vegetables by the retort, the several acids being the ordinary product of the still. It is this that renders animal substances more liable to the putrefactive fermentation, and vegetables to the vinous and acetous. Wool, and silk, yield more oil than most vegetables; cotton, indeed, contains very little, and linen not much more, although the seed of flax affords it in abundance. This accounts for the brighter flame of the animal substances during combustion, when also the presence of ammonia is distinctly perceived from the pungent smell which, in that case, is emitted. Silk, and wool, are much more easily decomposed than linen and cotton, from the enlarged sphere of affinity which their more numerous constituents produce. It is on this account, that the sulphuric, nitric, and muriatic acids, decompose, and weaken, the texture of silk and wool, while vegetables are but slightly affected by acids of the same strength. The nitric acid acts on the former by extricating their

* We would not, however, be understood to infer from this, that a knowledge of the structure and composition of the ultimate constituents of the substances in question, will much assist us in anticipating, without previous trial, the result of any process in bleaching; we merely infer that such knowledge may assist us to explain upon what the effects produced depend, and may suggest material improvements, both in efficiency and economy.

† This is well illustrated by what takes place in dying of a scarlet colour, the woollen cloth which is sometimes edged with cotton, as the cotton, being less easily affected, remains white after the wool has acquired the required shade; the same will happen if cloth be made with cotton warp and woollen woof, as has been experimentally shown by M. Dufay.—*Bancroft.*

nitrogen, separating the fatty matter, and forming carbonic and oxalic acids. The sulphuric, extricates their hydrogen, a small portion of their nitrogen, and leaves a carbonaceous residuum. The alkalies, again, destroy animal substances by combining with their oils, which sheath their causticity, and form soap, while they affect vegetables but slightly. Silk is the least liable, of all animal substances, to be acted upon by acids or alkalies, as it is more nearly allied than wool, to vegetables, in its structure and composition. But I shall give a more specific description of those differences, beginning with the animal substances.

1. *Silk.*—This substance is procured from cocoons formed by the caterpillar of the *Bombyx mori*, of Linnæus, previous to its transformation into a moth. It consists of filaments of great tenuity and comparative strength, which are uniformly covered by a very thin pellicle of a glutinous or gummy matter, which serves to render them stiff and elastic. They are usually of a yellowish tinge, from the combination of colouring matter, which M. Baumé found to consist of a resin perfectly animalized, affording, by distillation, the same products as other animal matters, and the concrete volatile alkali. (see Journ. de Phys. 1793.) This it is necessary to remove, in order to render the fibre pliant, and manageable, for the manufacture of cloth, which is commonly done by means of soap, according to a process described by Berthollet. Besides this gummy and colouring matter, M. Roard (Ann. de Chim.) found that there is another substance, like wax, which requires to be removed. He informs us that the gum is commonly in the proportion of 24 per cent., the colouring matter about 55 or 60, and the wax seldom more than 1, and often only about half that proportion. The gummy substance is soluble in water, and would be easily managed if the others were not present, for it unfortunately happens that the colouring matter cannot be dissolved by water; it is, however, soluble in alcohol, and also, together with the animal wax, capable of being removed by alkaline leys or by soap.* The silk procured from the cocoons of the Bombyx mori, seems to differ considerably in strength and composition, according to the different places in which the insects live; but my information is too scanty to be able to point out those differences with precision. In India and China, silk is procured from several other insects of the same tribe, which is strikingly different from the common silk. Dr. Roxburgh (Lin. Trans.) tells us of a phalena whose cocoons are remarkably soft, and white, or yellowish, but it being difficult to wind off the silk, it is spun like cotton, and

* It was found by Mr. Mushat that silk contains more carbon than any of the other substances employed in the manufacture of cloth. He distilled, in the dry way, 200 grains of white silk stuff, and during the process there was a violent discharge of bituminous flame and smoke. The residuum was formed into a caked coal of a dense compact structure; cellular, though not in the least brittle. The colour was iron-gray, with a faint shade of copper. When struck, it was sonorous in a high degree. It weighed 62 grs. and had consequently lost by the process 138 grs. Silk, then, is composed of 69 grains volatile matter, and 31 of oxide of carbon. (Phil. Mag. xxxiii. 4.)

possesses a durability almost incredible, the life of one person being seldom sufficient to wear out a garment of it. Its texture and composition must be very different from common silk, as it will not bear washing in hot water. The Doctor mentions another sort of silk which is coarse, durable, and dark coloured, and much worn by the Bramins. The silk from Nankin in China is naturally pure white; but the Chinese, according to M. Baumé, (Journ. de Phys. 1793,) bleach a great quantity of common silk, and pass it for Nankin.

On the Growth and Preparation of the Straw used for Plait, in the Tuscan trade.

The Highland Society of Scotland, in their list of Premiums for the present year, state, that "they have every reason to be satisfied with the success of the premiums offered last year, and although the specimens produced in consequence, have done uncommon credit both to the manufacturers, and to the operative people in this country; yet, the result of the inquiry which the society has been able to make into this important object, leads them to the conclusion, that "until farmers raise the straw for sale, it is not likely that the manufacture of Leghorn bonnets will become general in Scotland. If straw could be got to purchase at a reasonable rate in this country, the great difficulty in extending the manufacture would be removed."

They have accordingly offered several premiums for this important object, and they add as follows:—

"The following observations have been extracted from some valuable communications which have reached the society from Mr. Horace Hall of Florence, Mr. Boswell of Kingcausie, and others; and are inserted here as perhaps affording information on some points of management in the growth and preparation of the straw used in the Tuscan trade, which may not yet be quite familiar in this country."

"The seed from which the straw for plaiting is grown, is a small round grain of wheat, called *grano marzuolo*, or, more properly, *grano marzolano*. It is so called from being sown in the month of March, and differs from common wheat in appearance, from its rounder and shorter shape. It is an error to suppose hats are made from rye, or any other grain in Tuscany. This *marzolano* straw is cultivated for the sole purpose of being made into hats; and is grown chiefly in the vicinity of Florence, and on the hills on both sides of the valley of the Arno. The growth of the straw is thus almost exclusively confined to a limited part of the province of Tuscany. A few years ago, the Pope aware of the source of wealth which this manufacture produced in that quarter, attempted to introduce the culture of it into his States. From the habits of the people, difference of soil or climate, or from all these causes conjoined, the plan did not succeed; and the Grand Duke of Tuscany having now allowed the prepared straw to be exported, the idea of cultivating it elsewhere

nitrogen, separating the fatty matter, and forming carbonic and oxalic acids. The sulphuric, extricates their hydrogen, a small portion of their nitrogen, and leaves a carbonaceous residuum. The alkalies, again, destroy animal substances by combining with their oils, which sheath their causticity, and form soap, while they affect vegetables but slightly. Silk is the least liable, of all animal substances, to be acted upon by acids or alkalies, as it is more nearly allied than wool, to vegetables, in its structure and composition. But I shall give a more specific description of those differences, beginning with the animal substances.

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seems to be altogether abandoned. Tuscan women, in the mean time, have settled themselves in various places, such as Vienna, Petersburgh, &c., where they carry on the manufacture with straw grown in Tuscany.

"This seed is sown on good ground, but not rich; some sow it on poorish land. In general, vines and olives bound the fields in which it grows, or are planted at intervals in the interior of these fields, like orchards in this country. The practice in sowing flax is known to every agriculturist; and nearly the same holds in regard to the *marzolano*, where the qualities especially to be obtained are fineness, tenacity, and toughness.

"To obtain the first, it is sown so thick, that each blade touches another. Manure is never made use of on the ground to be under *marzolano*. The seed is sown on the ground in a flat state, and a person must be taught the method of sowing it, which is done "underhand." The seed is then covered in, by hoeing the ground with a draw hoe, about three times the size of our common turnip hoe. This is done as near the first of March as the season will permit. From the beginning to the middle of July, (according to the season,) it is ready, which is known by the ear being fully shot, but before it is formed into grain. The plant is then, if a good crop, eighteen inches in height. The straw is not cut, but plucked by main force from the soil, and then exposed for the purpose of bleaching, not in bundles, but scattered about in meadows or gravel grounds, exposed to the evening dew and the mid-day sun, until it is perfectly yellow; but constantly watched, to gather it together, and put it under cover at the least appearance of rain, which would spoil it, and make it turn out completely speckled. After it is sufficiently bleached, it is tied in bundles, and brought to the manufactory, where children are employed to pluck the only part of the straw which serves for plaiting, that is, what is comprised betwixt the ear and the first joint in the stalk. If the weather is fine, in fifteen days after the crop is pulled, it will be ready to work into plait, "treccie" as it is called. The natives say that the dew tends greatly to whiten it; but if any rain falls, it is ruined. The manner of separating the top joints, is by a smart jerk of the hand. These are made up for sale, and the remainder thrown to the dunghill, for no animal will eat it.

"To obtain the whiteness so much prized, the straw is smoked with sulphur previous to being worked; the plait is also smoked, and, lastly, the hat. About Sienna, the process is simply a little sulphur set on fire in the bottom of a large chest, bunches of the straw being placed on long hazel rods across, and the lid shut down. Elsewhere, the articles are described as being placed in a small close room, in which a chafing dish of sulphur is placed, and set fire to. Sometimes the operation requires to be done twice before it succeeds.

"The straw for use is classed or stapled like our wool. Children or inferior hands work the coarse thick straw, while good hands work the fine only. Whether fine or coarse, it is only the part on which the spike grows that is made use of, and it is always the same plait, consisting of thirteen straws, which is worked. In the fine plait,

there is a very great waste of straw, as they reject all that is in the least too thick, and they cut off a considerable part of the straw where it comes near the flower spike. Fine plait is not accounted good, unless very much drawn together, for which end it is worked very wet. The bunches of straw are always put into a small jar filled with cold water, which stands behind the worker. After being smoked and pressed, the plait is made up into hats by women who do nothing else; it is put together by the edges, not overlapped. On the operation of pressing a great deal depends. There are only two good machines for that purpose in the country.

"Such is the practice for procuring the hat straw. What they sow for seed is in other ground: not one fourth of the seed is used, and the grain is allowed to come to maturity in the usual way. It is said to be a capital wheat for *vermicelli*, *maccaroni*, &c. and also for making into bread.

"It ought to be taken into view, that, for the use of the manufacture in Scotland, the straw should not exceed 1-18th of an inch in diameter. When coarser, it does not answer the market; and much of the very finest straw is not required, because the bonnets made from it are too expensive."

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*On the Preparation of Artificial Slates.**

THERE have been for some years imported into Russia a species of Artificial Slates, manufactured by a person named *Alfuid Faxe*, of Carlscroon. These substances attracted the notice of several scientific men. M. Géorgi was instructed by the Academy of St. Petersburg to make an analysis of them, by which means he discovered their composition. They are a most invaluable substitute for slates; as they are much lighter, impenetrable by water, and incombustible. The following processes for manufacturing them, afforded the best results to M. Géorgi.

The substances employed, were 1st. A bolar earth, white, red, or ferruginous, according to circumstances. 2d. Chalk or Carbonate of Lime. 3d. Strong or English Glue. 4th. The Pulp of Paper. 5th. Linseed Oil.

The bolar earth and the carbonate of lime are reduced to powder separately, in a mortar, and passed through a silken sieve.

The glue is dissolved in water, in the usual manner.

The paper pulp employed is such as is known by the paper-makers, under the name of common paper pulp, (*papier bulle*). This is steeped in water, and the water afterwards extracted from it by means of a press. Instead of this pulp, we may employ with advantage the waste of white paper, or book-binders' cuttings; these must be boiled for twenty-four hours, and the water squeezed out by means of a press.

The linseed-oil employed must be raw.

* From the *Dictionnaire Technologique*.

The mass of paper being mixed in a mortar, with the dissolved glue, is made into a paste, by adding the bolar earth and carbonate of lime. The whole being well beaten together in the mortar, the linseed-oil is poured in from time to time, as fast as it can imbibe it. They then take a quantity of this mixture, and spread it with a spatula on a plank or board furnished with a ledge or border, to determine the thickness of the layer;—before this is laid on, however, the plank is covered with a leaf of common paper. They then place upon this mixture another leaf of paper, on which they lay another plank, and reverse the whole: they then lift off the bordered plank, together with the first sheet of paper. After this operation, they again reverse the *stone paper*, and lay it upon a plank strewed over with very fine sand by means of a sieve: they then remove the second plank, and the second sheet of paper; leaving the sheet of composition to dry.

These sheets neither crack nor break in drying; but they are liable to become twisted out of shape, and they are seldom smooth, or without lumps on their surface. To remedy these inconveniences, they are passed between the two cylinders of a flatting-mill, which perfectly unites and gives them firmness: they are then submitted for some time to the action of a press, which makes them perfectly straight and even. And, lastly, the two surfaces of each sheet are coated, either with boiled linseed-oil, or linseed-oil rendered drying by a little oxide of lead.

The following are those compositions which have afforded the best results:—

1st. One part of pulp (made from old paper and book-binders' cuttings), half a part of glue, one part of chalk, two of bolar earth, and one part of linseed-oil—form a thin, hard, and very smooth sheet.

2d. One part and a half of paper pulp, one of glue, and one of white bolar earth—produce a sheet very beautiful, hard and uniform.

3d. One part and a half of paper pulp, two of glue, two of white bolar earth, and two of chalk—produce a uniform sheet, as hard as ivory.

4th. With one part of paper pulp, one of glue, three of white bolar earth, and one of linseed-oil, we obtain a beautiful sheet, which has the property of being elastic.

5th. One part of paper pulp, half a part of glue, three parts of white bolar earth, one of chalk, and one and a half of linseed-oil—form a sheet infinitely superior to that obtained by the process No. 4. This substance has also the property of retaining whatever other shape may be given to it. A few grammes of Prussian blue give it a bluish-green tint.

We may substitute with advantage, in place of the carbonate of lime and the bolar earth (of which we have above spoken,) the *carbonated pulverulent lime*, which Fabbreni discovered in Tuscany; of which he manufactured his floating bricks, and to which he gave the name of *fossil farina*. In the year 1800, Faujas discovered in the department of Ardèche, four leagues distant from the banks of the Rhone, a considerable bed of this earth, in a place readily accessible.

This substance is not rare. Brongniart assures us that it is found, in a layer of a centimetre in thickness, on the lower or lateral surfaces of beds of coarse carbonate of lime. It is frequently found in the environs of Paris, but more particularly in the quarries of Nantz. This earth is white, as light as cotton, and is reduced to powder by the least pressure.

The various experiments made on these sheets of stone-paper, or artificial slates, have proved:—1st. That by a continued steeping in cold water for four months successively, they did not in the least change, nor increase in weight. 2dly. That on being exposed to a violent heat for five minutes, they were scarcely altered in form; but were converted into black and very hard plates: they merely appeared blackened, and somewhat scorched. They constructed a house of wood at Carlscroon, which was entirely covered and lined with these articles; they then filled it with combustibles, and set fire to it: the house resisted the action of the flames.—The experiment was repeated at Berlin, and with the same success.

The materials fit for making this stone-paper are to be found in all parts of the globe. The process is simple, and it requires only very facile manipulations: it may be used, with economy, for covering houses, instead of slates; and for which purpose its lightness renders it far preferable. In this case, it is secured, in large leaves, by copper nails, and the joints filled with cement. The whole being coated with an oil-colour, forms the lightest covering, and one the least penetrable by water.

The cement which we recommend for filling the joints between these sheets after being nailed on, is composed of linseed-oil rendered drying, white-lead and chalk, intimately mixed, and used in a nearly fluid state, in order that the composition may the better insinuate itself amongst the joints and interstices, and cover the heads of the nails.

We have seen, in the Exhibition at the Louvre, in the year 1819, the *stone-paper* invented by *M. Hirsch*, which is white, and possessed of all the properties of the composition described in No. 4. This artist kept his process secret; but we believe it to be the same as is employed in Sweden—as that discovered by M. Géorgi, and which we have here described. L.

ENGLISH PATENTS.

To James Rowbotham, *of the County of Surrey, and* Robert Lloyd, *of the County of Middlesex, Hatters, for their having Invented a certain Method of Preparing, or Putting together, certain Materials, Substances, or Things, for the purpose of being made into Hats, Caps, Bonnets, Cloaks, Coats, Trowsers, and for Wearing Apparel in general, and various other purposes.*

The material proposed by the patentees, to be employed for the foundations of hats, and for various other purposes, is cork; which is

to be sliced into thin sheets, by means of a machine similar to those used for splitting leather; or it may be prepared by an ordinary knife, or by various other means, to which processes the patentees lay no claim.

The cork to be employed for the above purposes, is to be reduced into very thin sheets, from about an eighth of an inch to a sixteenth of an inch in substance, and out of these sheets of cork, the shapes, that is, the foundations of the crowns and tips of hats, caps, &c. are to be made; which after being properly connected at the joints are to be covered with shaggy or plush silks, such as are commonly employed for the covering of hats.

The advantages of these cork foundations, are, that the hats made of them are extremely light and flexible, are perfectly water-proof, and from the porosity of the cork, allow the vapour arising from the perspiration of the head to escape through the hat; which will be found to afford great relief to the wearer when walking, and in warm weather.

The patentees propose, not only to employ cork in the thin sheets described above, but also to cut it into narrow strips, and unite the strips together by weaving it in a loom. These strips must be reduced very thin in substance, but may be cut to any breadth that may be deemed desirable or convenient. A warp of flax, cotton or other threads or yarns, is then to be laid in a loom, in the way practised in ordinary weaving; and the warp being opened by headles or otherwise as usual, the strips of cork are to be successively introduced as weft or shoot, in the manner that wires are introduced in weaving pile, and such kind of fabrics; the beating up being performed also in the common manner by the batten.

The materials thus woven, form a sort of cork cloth, which it is intended to cut out into the forms of parts of garments, and to attach these portions of the cloth together in any convenient way, for making them into cloaks, trowsers, and other things, which the patentees state, will be water-proof, warm, and light; and consider that these cork garments will be particularly desirable for sea-faring people, as they will effectually prevent the wearer from sinking in water.

Cork prepared by slicing into thin sheets, may be employed for a variety of other purposes, beside those above stated, particularly for coating damp walls, previously to papering them, and also for the sheathing of ships' bottoms; which objects come within the contemplation of the patentees, and are therefore claimed by them as their invention.—Enrolled October, 1826. [*Newton's Journal.*

To Joseph Cliseld Daniell, *of Stoke, in the County of Wilts, Clothier, for his Invention of certain Improvements in Machinery, applicable to the weaving of Woollen Cloth.*

The improvements proposed by the patentee apply to what are usually denominated power-looms, that is, looms which are actuated

by the power of steam or water. There are two objects intended to be accomplished by these improvements; first, a more powerful beating up of the weft or shoot in weaving woollen cloths, than has hitherto been effected in power looms; and secondly, a mode of lifting the warp, or chain as it is called, so as to throw a much greater portion than usual of the weft, or shoot, on to the face of the cloth; for the purpose of increasing the quantity of pile, and thereby improving the appearance of the cloth when finished.

The beating up of the weft, which in ordinary looms is produced by the hand of the weaver, who brings the lay forward with two smart strokes, which strike the reed against the weft thread, is, in the present improved loom, effected by means of a spring or springs attached to the breast beam, and to the lower bar of the lay.

The movements of the loom are produced by rotatory wheels with cams or tappets acting upon the different parts of the machinery, as may be seen by reference to several patent power-looms. The present patentee, however, does not claim the modes of moving the operative parts of the loom, but simply under this head, the spring or springs, for drawing the lay forward, with considerable force.

In order however, to explain this invention, it is necessary to say, that immediately beneath the lay, there is a rotatory cam, which as it revolves, acts against a piece extending from the under part of the lay, and by that means, forces the lay back, and retains it in that position while the shuttle is passing across, between the threads of the warp. As soon as the shuttle has passed, the cam escapes from the lay, and allows the spring connected to the lay, and to the breast beam, to pull the lay forward with considerable force, which causes the reed to beat up the weft as above said.

Various kinds of springs may be employed for this purpose, provided they are so placed as to draw the lay toward the breast beam.

A long blade spring is proposed, which is made fast to the breast beam at one end, and is attached to the lay near the middle, by a swivel joint; or, instead of being immediately attached to the lay, two other blade springs may be affixed to the lower bar of the lay, and these attached to the acting end of the former, which it is considered would soften the beating up stroke, and yet give all the required force. Or instead of these blade springs, helical wire springs might be employed, one end of the spring being secured to the breast beam, and the other to the lay.

The improved mode of lifting the warp, is by the employment of three headles as the harness, one third of the warp threads being tied up by each headle, and these being made to rise one at a time in succession by the movements of the machinery, previously to every throw of the shuttle, cause only one third of the warp threads to be above the weft, while two thirds are always below it. By this arrangement a greater portion of the weft is thrown on to the surface of the cloth on the right side, and the means afforded of drawing out a larger quantity of pile, which greatly improves the face of the cloth, when the gigging, shearing, and dressing, have been completed. —Enrolled April, 1826. [*Ib.*

To JOHN FREDERICK SMITH, *Esq. of Dunstan Hall, Chesterfield, in the County of Derby, for his Invention of certain Improvements in Machinery, for Drawing, Roving, Spinning, and Doubling Cotton, Wool, and other fibrous substances.*

THE subjects described in this specification, are a can with two moveable ends, and a bobbin composed of several pieces which take apart.

As respects the can, it is a cylindrical vessel of tin, of the kind usually employed for receiving the rovings of cotton, &c. from the machines: and the peculiar novel feature is, that both the ends of the can are made capable of being removed, instead of one end only as usual, by the ends having rims which fit into the cylinder, like the lid of a tin saucepan. These ends the patentee calls false bottoms.

The bobbins are made by sliding one tube of metal within another, similarly to the tubes of a telescope, the outer tube forming the barrel of the bobbin, and one of the ends sliding on, and off, in the same way.

These are the improvements in machinery for drawing, roving, spinning, &c. which constitute the subjects of the present patent, and the claims of the patentee to novelty of invention are—"1st. A can for drawing and roving with two false bottoms fitting equally into each end; one of the said bottoms being removed during the process of roving the fibrous substances in the can." The ingenuity of this part of the invention being shown, the reader is left to discover its utility by the exercise of his own imagination. The second claim is "a bobbin made of several parts, in such manner as to be capable of being taken to pieces, after any fibrous substance has been wound upon it, and entirely withdrawn from the said fibrous substance without disturbing the arrangement which was given to such fibrous substances upon the bobbin."—Enrolled December, 1825. [*Ib.*

To EDWARD SHEPPARD, *of Uley, in the County of Gloucester, Clothier, and* ALFRED FLINT, *of the same place, Engineer, for their new Invented series of Improvements in Machinery, for Raising the Wool, or Pile, on Woollen or other Cloths, by Points; by which the process is much facilitated, and a great saving effected; and part of which Improvements are also applicable to Brushing, Smoothing, and Dressing such Cloths, to the great benefit of the Public.*

THE first object of the patentee, is to economize the use of teasels, employed in raising the pile of cloth, as they consider that by the ordinary mode of using teasels, they are worn out and destroyed, much sooner than they ought to be, and consequently increase the expenses of the manufacturer. Instead, therefore, of setting the teasels in flat frames, and fixing these frames on to the peripheries

of large cylinders, as in all the gigging machines hitherto used, (and by which the teasels become crusted or worn on one side,) it is proposed to set the teasels in cylinders of small diameter, so that their rotation shall approximate nearer to the figure of the teasel, and consequently bring a greater portion of the surface of the teasel into operation.

There are various modes suggested, of setting the teasels in their frames, one of which is, by means of parallel plates, perforated with holes, through which holes, portions of the teasels are intended to protrude. When one part of each teasel has become worn by use, the confining plate is to be removed, and the positions of all the teasels changed, by the finger and thumb, so as to bring other parts into operation. Small pegs may be set into the periphery of the gig cylinder, and a teasel stuck upon each; or small spindles may be disposed over the surface of the cylinders, their ends being confined between parallel plates, upon which spindles, as axles, the teasels may be respectively mounted, and enabled to turn round. The teasels, must, in that case, be set in oblique rows, in order that they may be turned by the transversing of the cloth, which will prevent the cloth from being streaked, by bringing all parts of the teasels into action.

Another object proposed by the patentees, is to enable the teasels which have become spent by use, to be removed from the gig cylinder, and fresh ones introduced in their place, without suspending the operations of the machine. For this purpose, it is intended to adapt several gig cylinders to one machine, and to mount them upon arms extending from a common centre, or in rings, or by any other contrivance, so as to bring one cylinder at a time into action, and when that has worked long enough to have exhausted its teasels, then bring the next cylinder into action, by turning the frame; the former cylinder being in a situation to have its teasels replenished ready for future use, without having stopped the movements of the machine.

Between the several cylinders, breast boards, or rollers are to be introduced, for the purpose of regulating the pressure of the cloth upon the gig cylinders, and these are to be made adjustable; they are to have oblique ridges and grooves cut in them, for the purpose of keeping the cloth extended.

Brushing cylinders made with hairs or bristles, are to be placed within the machine, for cleaning the teasels; and other brushing cylinders are also to be adapted to the machine, for laying the pile of the cloth. Heated metal cylinders are to be employed, in connexion with the gig machine, for fixing the nap, and these are to be heated by steam admitted through hollow axles to their interior. Steam boxes are likewise to be employed, for drying the spent teasels.

There are no drawings attached to this specification, by which the intended constructions of the above described apparatus might be pointed out, which is the more to be regretted, as we perceive several features mentioned as claimed which have been embraced by

former patentees, or commonly practised by cloth manufacturers.—Enrolled May, 1825. [*Ib.*

Some further account of Ledsam's new Method, of Purifying Coal Gas.

The new mode of purifying coal gas, for illumination, mentioned in our last as the invention of Mr. Ledsam, appearing to possess considerable claims upon public attention, we have endeavoured to obtain some further information relative to the process, and in the absence of the specification, which is not yet enrolled, we beg to lay before our readers a few remarks connected with the subject, and a brief statement of the general features of the process, as well as we have been able to collect them.

Nearly thirty years have elapsed since the practical introduction of gas-lights, and it must be admitted that many ingenious and most important improvements have been suggested and adopted, in its production, from time to time, in proportion as it has been brought into more extensive use; but whilst the astonishing discoveries in chemistry, during the same period, have been successfully applied to so many operations connected with manufactures and the arts, it is a very singular fact that the purification of coal gas, which is obviously a chemical process, is at present conducted, nearly, as it was fifteen years ago.

In the infancy of its application to useful purposes, the simple passage of the gas through water, was considered a sufficient purification. In 1810, Mr. B. Cook, of Birmingham, recommended the use of lime-water; and although many patents have since been granted for newer methods, several of the largest gas companies have actually returned either to this old plan, or to some modification of it. Indeed, lime, in different states of humidity, or in solution, is universally employed. It is found, however, generally to be inconvenient for the purpose, as well on account of the large quantities required, as of the expense and labour attending its application, and not less on account of the nuisance and bulk of the refuse lime. In the largest works ten tons per day are thus consumed, and even the aid of a steam-engine, is necessary to agitate the solution.

As the efficacy of lime as a purifier depends chiefly on its alkaline properties, attempts have been made to introduce as substitutes for it, potash and soda; both of which are decidedly superior to lime, but the expense attending their use has hitherto prevented their adoption. This objection, however, cannot be urged against the volatile alkali, ammonia, which may be readily procured in ample quantity in all gas works, from the liquor deposited in the hydraulic main; and, when properly prepared, which may be done at a trifling expense, it becomes not only a better purifier, but is also very considerably cheaper than lime.

The following is a brief sketch of Mr. Ledsam's process:—In the first place, a quantity of the ammoniacal liquor is saturated with muriatic acid. It is then reduced by evaporation, until it will crystallize on cooling. A portion of the crude muriate of ammonia thus obtained, is mixed with about two-thirds its weight of quick-lime, and put into a retort, over a moderate fire. From this retort a copious stream of ammoniacal gas is given out, and is brought into contact and mixture with the coal gas, which is chemically acted upon and deprived of its impurities; after which it is passed through a vessel of water wherein the ammonia is retained, and whence *it may be re-produced for future use.* The muriate of lime, remaining in the retort after each operation, will serve instead of muriatic acid, to convert fresh quantities of ammoniacal liquor, to the state of muriate of ammonia.

The apparatus is simple and not expensive, and the principle may be immediately applied where the wet-lime system is in use. The materials are two-thirds less expensive, and not one hundredth part of the bulk of lime. The attendance on the largest work will not employ more than one man. The quantity of gas is greater than usual. The operation may be conducted in the open air, and the cost of purifying may be estimated at about three half-pence per thousand feet, exclusive of the patent right. [*Ib.*

Account of a New Phenomenon observed in the emission of Steam, and one which affects the ordinary Safety Valve. By M. Clement.

M. Clement has communicated to the Royal Academy of Science in Paris, some singular results observed by him, connected with steam. When steam is greatly compressed in a boiler, so that a strong current is made to blow out through a small orifice, a metal plate, or disc, being presented at a little distance from the orifice, is forcibly repulsed; but if it be brought near, and pressed, so as nearly to close the orifice, and cause the steam to escape in a star form, or radient direction, round the outside of the disc, an external pressure will be found to act upon the disc, and it can only be set at liberty by forcibly raising it.

If the aperture of the steam vessel be directed towards the earth, the disc, notwithstanding the downward pressure of the steam is added to its own gravity, will not fall, but remain suspended; and force must be employed to make it quit its position. The same result takes place, if the experiment be made with the strong wind of the bellows of a smith's forge.

In the first experiment, M. Clement ascertained that valves of ordinary strength, which are true discs, placed upon the orifices of boilers, present danger inherent in their form. When they are only lifted just enough to let a thin sheet of vapour escape from the aperture, it becomes impossible to raise them any more by the force of the steam; and if the production of steam be too rapid to be discharged

by this small opening, and the strength of the copper be unequal to resist its force, an explosion will take place, though the valves are partially open. This, though it has been thought incredible, is what has really happened.

M. Clement says, that time does not permit him to explain the discovery he has made of these singular phenomena; it is only known that he attributes them to a vacuum, which is formed in the steam at very high pressure, in consequence of the great swiftness of its molecules; and by the conical form of the tube, through which the vapour is passed, causing it to dilate itself towards the edge, much below the atmospheric pressure; the force of the atmosphere is thus enabled to act with sufficient strength on the moveable disc, to enable it to resist the vapour.

Security against danger, in this experiment, depends on taking care that there should be a sufficient distance between the openings and the edges of the disc. It is necessary that the first should be large, and the other small, otherwise the employment of a conical tube to the valve, would diminish the effect of the atmospheric pressure.

M. Clement is of opinion, that some length of experience will be necessary to become acquainted with the best mode of making secure valves, capable of preventing the danger to which he has alluded; and he strongly recommends that experiments should be made, keeping in mind the hints which he has given. [*Ib.*

NATURAL HISTORY.

THE BEAVER.

From vol. 2 of "American Natural History."* By John D. Godman, M. D. Professor of Anatomy in Rutger's College, N. Y. &c. &c.

Castor Fiber: L. Erxl. &c.

Le Castor, ou le Biévre: Briss. Regn. An. p. 133.

Le Castor: Buff. viii. pl. 36.

Castor Fiber: Sabine, App. p. 659. Say, Long's Exped. to the Rocky Mountains, vi. p. 464.

Truth, alike the object, and reward, of all rational inquiry, is too delicate and unobtrusive to be advantageously approached or estimated, unless the mental vision be entirely free from prejudice, and her votaries, for the sake of her unostentatious, though unfading charms, forego the pride of worshipping the fantastic creatures of their own imaginations. Accessible to all, who in the proper disposition seek her presence, how many ages have elapsed, during which fiction has been pursued in her stead, till at length opinion gains

* Just Published by Carey, Lea and Carey, of this city.

such strength, and prejudice so deep a root, that the semblance passes into general acceptation for the substance, and that which was at first the mere breath of speculation, becomes finally received, and accredited, as indubitable. Thankless is the office of the individual who ventures to overturn any of these *idols* of the mind; to displace the illusions of fancy, by cold reality, and disperse into thin air, the fairy world which credulity first called into existence, and indolent imagination perpetuates. It must be confessed, that occasionally, this is no pleasant task; yet it is one of the duties especially incumbent on the teacher of natural history, inasmuch as the exercise of imagination is always prejudicial to the study of nature; the sober reality of which, when correctly examined, possesses an interest for transcending that of all fugitive beauties bestowed by this deluding faculty of the mind.

Who has not heard of the wonderful sagacity of the *beaver*, or listened to the laboured accounts of its social and rational nature? Who that has read the impassioned eloquence of Buffon, to which, nothing is wanting but truth, in order to render it sublime, can forget the impression which his views of the economy and character of this species produced? The enchanter waves his wand, and converts animals, congregated by instinct alone, and guided by no moral influence, into social, rational, and intelligent beings, superior to beings high above them in organization, and even far more exalted than vast tribes of that race which has been justly and emphatically termed "lords of the creation." Alas, for all these air-drawn prospects! while we endeavour to gaze upon their beauties they fleet away, and leave no trace behind.

The injury the mind receives from this source is scarcely to be appreciated, and among others, the false notions we form concerning the relative perfection and excellence of the plan of nature, may be considered as of the first magnitude. The beaver, for instance, is endowed with singular instincts, and performs actions worthy of our admiration; yet the beaver is not more sagacious than the ant, or the bee, creatures far removed from it in every respect; neither are its moral qualities better than those of the common rat. Each according to its instinct, provides for the safety and support of itself and its offspring, each obeys the impulse of a power beyond its own control, and each remains through countless generations, the same in point of intelligence;—untaught, incapable of teaching, and as well qualified to perform all the singular actions of its predecessors, if removed at the earliest age, from its kind, as if it had grown to maturity in their midst, and aided in their operations from the time its strength became sufficient to the task.

After rejecting the exaggerated facts, as well as the numerous fictions, relative to this animal, ample scope will still remain for the exercise of our admiration; for although the beaver is in no respect exclusively wonderful, yet its character and habits are such as to render it highly interesting. We shall, therefore, give a plain, unvarnished statement of facts, obtained from the most authentic

sources, and afterwards present some sketches of what, although frequently repeated in books of acknowledged authority, may be termed the *fabulous history* of the animal. This will prove serviceable as well as amusing, as it will lead the inexperienced to receive wonderful narrations of the intelligence, &c. of animals, with enough of scepticism to prevent them from being betrayed into error.

The general aspect of the beaver, at first view, would remind one of a very large rat, and seen at a little distance it might be readily mistaken for the common musk-rat: but the greater size of the beaver, the thickness and breadth of its head, and its horizontally flattened, broad, and scaly, tail, render it impossible to mistake it for any other creature, when closely examined. In its movements, both on shore and in the water, it also closely resembles the musk-rat, having the same quick step, and swimming with great vigour and celerity, either on the surface, or in the depths of the water.

In a state of captivity, or insulation, the beaver is a quiet, or rather, a stupid animal, evincing about as much intelligence as a tamed badger, or any other quadruped which can learn to distinguish its feeder, come when called, or grow familiar with the inmates of the house where it is kept. It is only in a state of nature, that the beaver displays any of those singular modes of acting, which have so long rendered the species celebrated: these may be summed up in a statement of the manner in which they secure a sufficient depth of water to prevent it from being frozen to the bottom, and their mode of constructing the huts in which they pass the winter.

They are not particular in the site they select for the establishment of their dwellings, but if it be a lake or pond where a dam is not required, they are careful to build where the water is sufficiently deep. In standing water, however, they have not the advantage afforded by a current for the transportation of their supplies of wood, which, when they build on a running stream, is always cut higher up than the place of their residence, and floated down.

The materials used for the construction of their dams, are the trunks and branches of small birch, mulberry, willow, poplar, &c. They begin to cut down their timber for building early in the summer, but their edifices are not commenced until about the middle or latter part of August, and are not completed until the beginning of the cold season. The strength of their teeth and their perseverance in this work may be fairly estimated by the size of the trees they cut down. Dr. Best informs us that he has seen a mulberry tree, eight inches in diameter, which had been gnawed down by the beaver. We were shown, while on the banks of the Little Miami river, several stumps of trees, of at least five or six inches in diameter, which had evidently been felled by these animals. These are cut in such a manner as to fall into the water, and then floated towards the site of the dam or dwellings. Small shrubs, &c. cut at a distance from the water, they drag with their teeth to the stream, and then launch and tow them to the place of deposit. At a short distance above a beaver-dam, the number of trees which have been cut down appears truly surprising, and the regularity of the stumps which are left might lead

persons unacquainted with the habits of our animal, to believe that the clearing was the result of human industry.

The figure of the dam varies according to circumstances. Should the current be very gentle, the dam is carried nearly straight across; but when the stream is swiftly flowing, it is uniformly made with a considerable curve, having the convex part opposed to the current. Along with the trunks and branches of trees they intermingle mud and stones, to give greater security, and when dams have been long undisturbed and frequently repaired, they acquire great solidity, and their power of resisting the pressure of water and ice is greatly increased by the willow, birch, &c. occasionally taking root, and eventually growing up into something of a regular hedge. The materials used in constructing the dams, are secured solely by the resting of the branches, &c. against the bottom, and the subsequent accumulation of mud and stones, by the force of the stream or by the industry of the beavers. In various parts of the western country, where beavers are at present entirely unknown, except by tradition, the dams constructed by their labours are still standing securely, and in many instances serve instead of bridges to the streams they obstruct. There are few states in the Union in which some remembrance of this animal is not preserved by such names as *Beaver-Dam*, *Beaver-Lake*, *Beaver-Falls*, *&c.*

The dwellings of the beaver are formed of the same materials as their dams, and are very rude, though strong, and adapted in size to the number of their inhabitants. These are seldom more than four old, and six or eight young, ones. Double that number have been occasionally found in one of the lodges, though this is by no means a very common occurrence.

When building their houses, they place most of the wood crosswise, and nearly horizontally, observing no other order than that of leaving a cavity in the middle. Branches which project inward, are cut off with their teeth, and thrown among the rest. The houses are by no means built of sticks first and then plastered, but all the materials, sticks, mud and stones, if the latter can be procured, are mixed up together, and this composition is employed from the foundation to the summit. The mud is obtained from the adjacent banks, or bottom of the stream, or pond, near the door of the hut. Mud and stones, the beaver always carries, by holding them between his fore paws and his throat.

Their work is all performed at night, and with much expedition. When straw or grass is mingled with the mud used by them in building, it is an accidental circumstance, owing to the nature of the spot whence the latter was taken. As soon as any part of the material is placed, where it is intended to remain, they turn round and give it a smart blow with the tail. The same sort of blow is struck by them upon the surface of the water, when they are in the act of diving.

The outside of the hut is covered, or plastered, with mud, late in the autumn, and after frost has begun to appear. By freezing, it soon becomes almost as hard as stone, effectually excluding their great enemy, the wolverene, during the winter.—Their habit of walking

over the work frequently, during its progress, has led to the absurd idea of their using the tail as a trowel. The habit of flapping with the tail is retained by them in a state of captivity, and, unless it be in the acts already mentioned, appears designed to effect no particular purpose. The houses, when they have stood for some time, and been kept in repair, become so firm from the consolidation of all the materials, as to require great exertion and the use of the ice-chisel or other iron instruments to be broken open. The laborious nature of such an undertaking may easily be conceived, when it is known that the tops of the houses are generally from four to six feet thick at the apex of the cone. Hearne relates having seen one instance in which the crown or roof of the hut was more than eight feet in thickness.

The door or hole leading into the beaver-hut, is always on the side farthest from the land, and is near the foundation of the house, or at a considerable depth under water. This is the only opening into the hut.

The large houses are sometimes found to have projections of the main building thrown out, the better to support the roof, and this circumstance has led to all the stories of the different chambers, or apartments, in beaver-huts. But these larger edifices, so far from having several apartments, are either double or treble houses, each part having no communication with the other, except by water. Upwards of twelve such dwellings have been seen under one roof, and, excepting two or three of them, the whole of the remainder had no communication unless by water, each having its own door into the dam, which is doubtless well known to the inmates, who may have comparatively little intercourse with each other. It is a fact, that the musk-rat is sometimes found to have taken up his abode in the huts of the beaver; the otter also occasionally intrudes his company. The latter animal, however, is a dangerous guest, for if provision grow scarce, it is not uncommon for him to devour his host.

The northern Indians believe, that the beavers always thicken the northern walls of their houses much more than the others, in order more effectually to resist the cold. In consequence of this belief, these Indians always break into the huts from the south side.

All the beavers of a community do not co-operate in the fabrication of houses for the common use of the whole. Those which are to live together in the same hut, labour together in its construction, and the only affair in which all seem to have a joint interest, and upon which they labour in concert, is the dam, as this is designed to keep a sufficient depth of water around all the habitations.

In situations where the beaver is frequently disturbed and pursued, all its singular habits are relinquished, and its mode of living changed, to suit the nature of circumstances, and this occurs even in different parts of the same rivers. Instead of building dams and houses, its only residence is then in the banks of the stream, where it is now forced to make a more extensive excavation, and be content to adopt the manners of a musk-rat. More sagacity is displayed by the beaver in thus accommodating itself to circumstances, than in any other ac-

tion it performs. Such is the caution which it exercises to guard against detection, that were it not for the removal of small trees, the stumps of which indicate the sort of animal by which they have been cut down, the presence of the beaver would not be suspected in the vicinity. All excursions for the sake of procuring food are made late at night, and if it pass from one hole to another during the day time, it swims so far under water as not to excite the least suspicion of the presence of such a voyager. On many parts of the Mississippi and Missouri, where the beaver formerly built houses according to the mode above described, no such works are at present to be found, although beaver are still to be trapped in those localities. The same circumstances have been remarked of the European beaver, which has been thought to belong to another species, because it does not build. This, however, as may readily be inferred from what we have just stated, is no test of difference of species.

These animals also have excavations in the adjacent banks, at rather regular distances from each other, which have been called *washes*. These excavations are so enlarged within, that the beaver can raise his head above water in order to breathe without being seen, and when disturbed at their huts, they immediately make way under water to these washes for greater security, where they are more readily taken by the hunters, as we shall presently discover.

The beaver feeds, principally, upon the bark of the aspen, willow, birch, poplar, and, occasionally the alder, but it rarely resorts to the pine tribe, unless from severe necessity. They provide a stock of wood from the trees mentioned, during the summer season, and place it in the water opposite the entrance to their houses. They also depend in a great degree upon the large roots (of the *nuphar luteum*,) which grow at the bottom of the lakes, ponds, and rivers, and may be procured at all seasons. It is remarked that these roots, although they fatten the beaver very much, impart a rank and disagreeable taste to its flesh.

The number of young produced by the beaver at a litter, is from two to five. Females have been killed in which six young were found, but this occurred only in two instances out of many hundreds examined at different stages of gestation.* During the season of union, the voice of both sexes resembles a groan, the male having a much hoarser note than the female. The young beavers whine in such a manner as closely to imitate the cry of a child. Like the young of most other animals they are very playful, and their movements are peculiarly interesting, as may be seen by the following anecdote, related in the narrative of Capt. Franklin's perilous journey to the shores of the Arctic Sea.—"One day a gentleman, long resident in the Hudson's bay country, espied five young beavers sporting in the water, leaping upon the trunk of a tree, pushing one another off, and playing a thousand interesting tricks. He approached softly, under cover of the bushes, and prepared to fire on the unsuspecting creatures, but a nearer approach discovered to him such

* Hearne.

a similitude betwixt their gestures and the infantile caresses of his own children, that he threw aside his gun and left them unmolested."

[TO BE CONTINUED.]

Animadversions on MR. GENET'S *Reply, to "Remarks on his Memorial on the Upward forces of Fluids;" with additional Observations on the Merits of that work. By the* EDITOR.

"The baseless fabric of a vision."

OUR readers are reminded, that in our second volume, p. 41, we re-published, from the "Boston Journal of Philosophy and the Arts," a notice of Mr. Genet's Memorial; and to this notice, appended a few remarks of our own. Dr. Pascalis of New York, in the 11th volume of the "American Journal of Science and the Arts," edited by Dr. Silliman, gave an abstract of the "Memorial," accompanied by the plates intended to illustrate the subject; and made a number of vituperative remarks, which elicited some further observations from us, in our number for January last, to which we refer our readers. Mr. Genet, in the 1st and 2d numbers, of the 12th volume of Silliman's Journal, has undertaken to vindicate his "Memorial," and to charge us with ignorance and presumption, on account of the course we had pursued in our notice. All this was exactly what we anticipated, as we had treated the whole scheme as whimsical, unphilosophical, and even ridiculous; and the more we have examined it, the more perfectly have we been convinced, that this was the only treatment which it merited. In the present instance, we shall depart in some degree from this course; which we are induced to do, from the circumstance of its having derived an adventitious importance, in consequence of its publication in one of the first scientific Journals of our country. This "airy nothing," has thus obtained "a local habitation, and a name," which will protect it from that early oblivion, to which it would otherwise have been consigned.

It is conceded, on all hands, that there is a legitimate use of ridicule, and that this weapon is very properly employed against extravagance, fanaticism and presumption, whatever be the subject on which they are manifested; and although it may be impossible for the individual, whose projects are submitted to such an ordeal, to separate himself, from the severities intended for his labours only, yet this distinction ought to be made by others. There is, perhaps, no subject in which the generality of men, otherwise intelligent, manifest so much ignorance, as on that of mechanics; the wildest speculators, have from this cause, obtained the support of gentlemen whose names are authoritative, in consequence of their having been distinguished for their knowledge in the natural sciences, or in other

branches not requiring an acquaintance with the principles of mechanics. We also see such men themselves, occasionally run wild upon this subject, either pursuing the phantom, perpetual motion, or other schemes equally at variance with all sound philosophy; and although in this case, we may, at once, pronounce, that they are not mechanical philosophers, still they may be, not only very good, but, on other subjects, very wise men; and merit to be, members of the Institute of France, of the Philosophical Society of New York, or Presidents of the American branch of the Linnæan Society of Paris.

That Mr. Genet should be displeased with our manner of treating his views, is perfectly natural, as he, undoubtedly has the most perfect confidence in them. We really believe that he is as sincere as captain Symmes, and we also think that their theories are equally hollow. The more extravagant, however, the theory, the less likely is its advocate to be convinced of its fallacy; but although the individual may be *incurable*, the spreading of his disease may sometimes be prevented by well applied caustics. Mr. Genet may probably recollect, that about seventeen or eighteen years ago, a number of gentlemen, living in Albany, and some of them very learned men, united to build a boat to be propelled by the motion of a pendulum, urged by the strength of only three or four men. This was to supply the place of a steam engine; a certain Mr. Letton was the proposer of the scheme, and, although our influence was sufficient to save some of our friends, certain intelligent civilians, and other gentlemen of worth and standing, *paid for it*. In the *Athens of America*, sage and wary members of many learned societies, have been fain to hang their harps upon the willows, after having sung the praises of Redheffer's perpetual motion; and without claiming inspiration, we fear not to prophesy, that a similar termination will be witnessed, should the citizens of the *Commercial Emporium*, be induced to become "associates for the essay of a hydronaut."

Mr. Genet has brought against us certain grave charges, some of which shall receive a passing notice; and, although we are not so vain as to expect to succeed in convincing him, that he has himself committed the very error which he ascribes to us, we may perhaps be more fortunate with *impartial judges*. In speaking of the first article in which his work was noticed, he says "but I find, that excepting a few additional acerbities, and ungenteel allusions to my advancing age, the editor has, &c." The following is the only passage to which it is possible he can allude. "We were, however, unwilling to interfere with the whimsies, and to disturb the reveries, of a very respectable man, who, probably, has cherished fond hopes of this child of [his] old age; it was the more unpleasant to us, as we have had some personal knowledge of the gentleman, and have respected him highly." (Vol. 2, p. 44.) Few persons, we apprehend, will find in this language, acerbities, and ungenteel allusions.

In the last number of Silliman's Journal, there are several expressions, which, as they are similar in character, may be grouped together, that a judgment may be formed, whether we might not justly retort, one, at least, of the charges brought against us. "The asperi-

ties of my censor, and his unfair subversions, misnomers, and curtailments." "The sneers of Dr. Jones." "Dr. Jones garbles when he says that I call a vacuum a gas." "The denomination of *gaseous* fluids, which I have given to steam, and not to the vacuum, as the Dr. very unfaithfully quotes it." "Less conceited appellate judges," *et cum multis aliis.*

The foregoing charges would be truly formidable, were they not deficient in the essential property, correctness; we have certainly curtailed, because we have not quoted the whole book, but have not either garbled, subverted, or unfaithfully quoted; neither have we intentionally misrepresented the author's meaning, in a single instance.

We will now proceed to notice some of the observations of Mr. Genet, in his last "reply," and will afterwards attempt a short analysis of the principal projects brought forward in the "memorial," which has given rise to this disquisition. Should we call the "submissive philosophy" of Mr. G. into action, it will neither merit or receive our *sneers*, as we shall carefully draw the line between this gentleman, and his schemes; and indeed, were it not for the respectability of the former, the latter would not have received any public notice from us, however they might have served for the amusement of a leisure hour.

Probably, but few of our readers, have seen the "memorial," although many of them will have become acquainted with its leading features, from the communication of his friend Dr. Pascalis, in Vol. 11, p. 339, of Silliman's Journal. This communication contains all the plates which are given in the 'memorial.' They are curiosities, and should be examined by all who have an opportunity to do so. For the sake of those who have not this advantage, we will endeavour, by our extracts, and explanations, to give a view of the subject, sufficiently clear to enable them to judge of the merits of the controversy.

Mr. Genet has, in p. 312, 313, of Silliman's Journal, quoted from the Franklin Journal of January last, our animadversions on his description of the vis motrix of the steam engine; and proceeds through two or three pages, next succeeding, to state the vast amount of information on this subject, which, in the year 1784, he derived from a conversation with its great improver, Mr. Watt; "all which" he says, "is perfectly present to my memory, my mental retentive faculties being preserved by the invigorating exercise of a laborious country life." It must be confessed that the extent of information which he displays, accords with his own history of its attainment, and does great credit to a recollection of between forty and fifty years standing. The very reverse of credit, however, would be due to one who professed to have obtained his knowledge of the engine, from books, and observation, were his information as meagre, as that of our author.

The various errors committed by Mr. Genet, in his attempt to describe the engine, in his memorial, are followed, in his reply, by others equally palpable. It may be said, that although the existence of these errors be admitted, they do not affect the merit of his own

inventions; but let it be remembered that this merit is altogether gratuitous; that Mr. G. has attempted to run a parallel between his hydronaut, and the steam engine, without understanding the operation of the latter; and that there is but little probability, that the world will be presented with any of those great discoveries, which involve a long train of reasoning, and correct theoretical, and practical knowledge, by one who has, manifestly, not only forgotten what he must once have known, but who has ceased, for forty years, to keep pace with the improvements in science, and the application of mechanical and chemical principles, to the useful arts. In the race of improvement, the starting point, should be the goal at which others have arrived.

We have asserted that Mr. G. is not acquainted with the structure, and operation, of the steam engine; it is incumbent on us to prove the correctness of this assertion, and unfortunately for this gentleman, he has rendered the task perfectly easy. In his reply p. 316, Mr. Genet, after detailing a portion of the information received from Mr. Watt, says, "None of the subsequent improvements were omitted by Mr. Watt, to show the gradual progress of the steam system of mechanics, and reach his own improvement; *in the first place*, upon the open ended cylinder, in which the expansive force of steam was employed to raise the piston, which in its fall, after the destruction of the steam, as I have stated it, became, under the pressure of the atmosphere on the piston, and the weight of the said piston, the *available force*. *And in the second place*, upon the tight cylinder which is constructed in such a manner, that on one side, instead of the atmosphere, the steam is made to press on the piston, whilst on the other side the cylinder is open to the condenser."

"This summary description of the two different modes of guiding and using the power of steam, improved in succession by Mr. Watt, and which have both their respective advantages and disadvantages, and are both in use, will, I presume, sir, satisfy you and your readers, that, in the critique of the parallel which I have drawn between the operation of the steam-piston in an open cylinder, and my hydrostat, equally placed in an open cylinder, Dr. Jones has proved either his ignorance of the difference between the open ended cylinder, practically called the *atmospheric engine*, and the tight cylinder, called the *double acting engine*, or that he has purposely selected the complicated operation of the double acting engine, in which the pressure of the atmosphere is no more used, or of the high pressure engine, (in which, on account of its overwhelming force, the pressure of the atmosphere is not taken into account, and the cylinder is left open to the air,) for the *unfair* purpose of showing that my parallel was incorrect, and my definition of the steam-engine injudicious. Had he known, or *candidly* considered, that in the open ended cylinder the direct force of the steam goes only to raise the piston, and that the expansive force of that steam being condensed, the vacuum created determines the fall of the piston, under its own weight and the incumbent pressure of the atmosphere, equal, on every square inch of the area of the piston, to 15 pounds, he would not have

asserted, 'that the pressure of the atmosphere and the weight of the piston were not necessary to Mr. Watt's engine, and served only to abstract from its power.'"

"There is in reality no pressure of the atmosphere in Mr. Watt's double acting engine, which Dr. Jones has here in view. But if there is none, how can it abstract from its power? And again, if the piston works in the vacuum, as Dr. Jones has told us it did, what difference can its levity or its weight make in its power, if in vacuo, according to Newton, the gravitation of a feather and of a ball of lead, compels them to obey, with the same speed, the proportionate force that draws them towards the centre of the earth?"

Some of those who know us intimately, will smile at the idea of our being charged with ignorance upon the subject of the steam-engine, by one who could write such paragraphs as those just quoted. But let it be kept in mind, that this is from the pen of one who "is not a philosopher of common stamp," a member of several learned societies, and one who has been the pupil and associate of men who have greatly enlarged the boundaries of science, and illuminated the world by their discoveries. Let all this have its proper weight, as it appears to form one of the strongest points, in the argument of our opponent.

Mr. Genet says, that "Dr. Jones has proved either his ignorance of the difference between the open ended cylinder, practically called the *atmospheric engine*, and the tight cylinder, called the double acting engine, or that he has purposely selected the complicated operation of the double acting engine," "for the *unfair* purpose of showing that my parallel was incorrect, and my definition of the steam-engine injudicious." Had this paragraph been written by some injudicious friend to Mr. G. we should have been inclined to have exonerated that gentleman, from the tissue of error which it involves, but it is from his own pen, and must therefore, be treated accordingly. Let us first ascertain who *selected the double acting engine*, as the subject of comparison, for the *unfair* purpose of showing the parallel to be incorrect. In page 61 of his memorial, in the very paragraph in which Mr. Genet runs the parallel, he says, "now let us examine if by mechanical means we can avail ourselves of the upward force of an hydrostat, with as much advantage as Mr. Watt has availed himself of the downward force of the piston, and weight of the steam engine, to procure the rotatory motion so ingeniously and successfully applied by Mr. Fulton, to navigation. But before I avail myself of the hydrostatic power to accomplish that object, as I intend to progress step for step *(pari passu)* in a parallel line with the steam engine, I must first settle a perfect balance of forces between us, and take as a pattern one of the largest boats plying on the Hudson, for example the Chancellor Livingston."

That Mr. Genet supposed the engine on board the Chancellor Livingston, and the other boats on the Hudson, to be acted upon by atmospheric pressure, is evident; and this certainly gives a degree of consistency to remarks, which, without this admission, would be altogether inexplicable. Will Mr. Genet inform us,

in what part of the United States, we can see an atmospheric engine? Will he point out any engine, in any part of the world, in which Mr. Watt has availed himself of this power? or "of the downward force of the piston and weight of the steam engine, to procure the rotatory motion?" The fact is, that one of the earliest improvements of Mr. Watt, and one made long before he had constructed the double acting engine, was the abandoning altogether the employment of atmospheric pressure, as a motive power; yet, notwithstanding this fact, which Mr. G. might undoubtedly have learned from many volumes in his own library, hear what he says; "the two different modes of guiding and using the power of steam, improved in succession by Mr. Watt, and which have both their respective advantages and disadvantages, and are both in use, &c." I do not suspect that this is "*unfair*" on the part of Mr. G., or that he has intended to deceive, but I certainly do think, that he "has proved his ignorance of the difference between the open ended cylinder, practically called the *atmospheric engine*, and the tight cylinder, called the *double acting engine*;" and also, that he is entirely ignorant of the structure of Watt's single acting engine, which requires a tight cylinder; that is, a cylinder closed at top, with the piston rod passing through a stuffing box, just as in the double engine. We presume that Mr. G. once understood the action of the old atmospheric engine, but if he did, he has now forgotten it. His description of this, is equally incorrect, with his account of those of Mr. Watt; when attempting to show our *ignorance*, or want of *candour* he says, (reply, p. 316,) "Had he known or candidly considered that in the open ended cylinder, the direct force of the steam goes only to raise the piston, and that the expansive force of that steam being condensed, the vacuum created determines the fall of the piston under its own weight, and the incumbent pressure of the atmosphere, equal on every square inch of the piston, to 15 pounds, he would not have asserted 'that the pressure of the atmosphere and the weight of the piston, were not necessary to Mr. Watt's engine, and served only to abstract from its power.'" Certainly, we did not *know* all these things, and *candidly*, or rather, confidently aver, that they are not facts. Had this description of the engine been intended as a travestie, its success would have been perfect. We scarcely know, how any one could contrive to thread a greater number of errors, on a string of the same length. The *direct force of the steam, does not go to raise the piston;* the steam merely balances the pressure of the atmosphere, and the piston is raised by a weight suspended to the opposite end of the beam, which weight is considerably heavier than the piston itself. The piston does *not* "fall under its own weight, and the incumbent weight of the atmosphere," but, on the contrary, a considerable portion of the pressure of the atmosphere, is expended in raising the heavy counterpoise of the piston. The critique which follows, serves fully to confirm this gentleman's want of information, upon the subject which he undertakes to discuss. "There is" he says, "in reality, no pressure of the atmosphere in Mr. Watt's double acting engine, which Dr. Jones has here in view, but if there is

none, how can it abstract from its power? and again, if the piston works in the vacuum, as Dr. Jones has told us it did, what difference can its levity or its weight make in its power, if in vacuo, according to Newton, the gravitation of a feather and of a ball of lead, compels them to obey with the same speed, the proportionate force that draws them towards the centre of the earth?" Here, by fair inference, the fallacy that the pressure of the atmosphere, operates in Watt's single acting engine, is repeated. We are also asked "how the air of the atmosphere, can abstract from its power?" Will not the air pump, which is absolutely necessary to its action, and which consumes no inconsiderable portion of the power of the engine, answer this question? Has not Mr. G. answered it in the following quotation from the very page, on which he makes the inquiry? "a perfect vacuum cannot be procured; the air that remains, or that is formed in the cylinder after the condensation, or the air which enters the steam vessels, with the condensing water, and the gas, air, or steam, which forces itself between the piston and the sides of the steam vessels, let the collar through which the piston rod must work, be made ever so tight, and close, cannot be drawn out, or excluded entirely, and will always, in all kinds of engines, oppose a gradual decrement to the descending power of the piston."

The philosophy of the question respecting the fall of bodies in vacuo, is much more modern than that of Newton, or of any other philosopher with whom we are acquainted, with the exception of Mr. G.—Newton never confounded together, momentum and velocity, but taught that the former was compounded of velocity and quantity of matter. Where, in his Principia, his Optics, or any other of his works, has he said that a feather, and a large mass of metal, such as the piston of a steam-engine, would weigh alike, or descend with the same force, in vacuo? Really, there is in this world, more than one person, who might derive information by being "condemned to study again, his experimental, and mechanical philosophy."

"Dr. Jones *garbles*, when he says that I call a *vacuum a gas*, and the *vapour of water atmospheric*." We quoted the whole sentence, in Mr. Genet's own words, and if this be to garble, we do not understand the meaning of the word. Where an opinion is obscurely expressed, we might misinterpret, and in this case we should wish to be corrected. The following is the paragraph to which Mr. G. alludes. "How does the steam engine perform that operation; how does it create that *vis motrix*, that moving force, which is the mechanical life of the machine? By the alternate increase and decrease of temperature, which produces in the cylinder two kinds of fluids, the one gaseous, the other atmospheric, by means of which the piston rises and falls." Now it so happens that when the engine is in operation, there is a vacuum on one side of its piston, and steam on the other; it follows, therefore, that if Mr. G. does not call a *vacuum a gas*, and the *vapour of water atmospheric*, he, of course, calls *the vacuum atmospheric*, and the *vapour of water a gas*; and from his explanation it appears that the latter was his meaning; but as we were not then aware that he supposed all steam-engines to be atmospheric, we

were unable to construe him correctly. It is, certainly, very "clear that atmospheric air itself is a gas," and assuredly, we could not suspect, that he who has had *Condorcet*, *Bailly*, *Lavoisier*, *Sage*, and *Brisson*, for his masters in chemistry, mineralogy, and philosophy, and who was the intimate of Watt, and of Priestley, would consider it as a simple gas; but what are Mr. G.'s peculiar views respecting its compound nature, he has not informed us.

We have greatly extended our remarks on the errors in philosophy, and the want of information on the nature of the steam-engine, which Mr. Genet so constantly exhibits. But this prolixity has appeared to be necessary, in consequence of the confidence with which that gentleman has pronounced his opinions; it has also been imperiously called for, by the charge of ignorance which he prefers against us, whilst for himself he claims a competent knowledge, obtained "by frequent observations made on board of our steam-boats, and in our steam-engine manufactories," "on the origin, progress, and improvement of the steam power, and the theory of aeriform fluids;" and declares, (p. 315,) that he obtained, "from Messrs. Watt and Boulton, and particularly from the first, not only the *most extensive information*, on the great improvements which had been made, in applying the gigantic power of steam to almost all the arts, but also on its beginning and history, all which is perfectly present to my memory."

Here are claims to information and knowledge, which ought, surely, to have been amply sufficient, to have sustained him, calm and unmoved, amidst all our "aspersions, unfair subversions, misnomers, and curtailments;" but, it has been an easy, though by no means a pleasant task, to show that these high claims, are preferred by one, whose modicum of knowledge, is limited to the action of the old atmospheric engine, and that even in this, it is altogether imperfect.

[TO BE CONTINUED.]

FOR THE FRANKLIN JOURNAL.

Observations on Centrifugal Force, founded upon the Theory, attempted to be established, in the Essay on Falling Bodies. By THOS. W. BAKEWELL, ESQ.

THE weight of matter has always been taken as a measure of its quantity; but it is only a comparative measure, for a body of a certain weight at one place, may be supposed to lose half its weight when taken to another, by a diminution of gravitating force, or, as at the centre of the earth, where all attractions are balanced, to have no weight; but we cannot therefore say, the body is annihilated, or has ceased to be matter.

As relates to the laws of motion, and attraction of gravitation, I assume as axioms, that "doubling the quantity of matter in a given body, produces the same result as doubling the gravitating force," and that "the inertia of matter is always as the gravitating force."

Inertia is that property in matter, which makes it resist a change either, from rest to motion, from motion to rest, or any change in the *direction* of its motion.

The resistance to change in the direction of its motion, is, "centrifugal force."

If we give a whirling motion to a bullet at the end of a string, and suddenly let go the string, the bullet will fly off in a right line, and at a tangent to the circle described, BUT NOT BY CENTRIFUGAL FORCE.

The centrifugal force, is the resistance given by the bullet to the constantly changing direction of motion in describing a circle, and is expressed by the tension of the string;* but the bullet will not fly off in the direction of the string. If we suppose an object moving in a right line, to be suddenly attracted by a body perpendicularly to its line of motion, and in such force, as should draw the object from its rectilinear motion, so as to describe a circle round the body; and that, when it had arrived at the same point at which the attraction commenced, the attraction should as suddenly cease, the object would then continue its motion in a right line; NOT BY CENTRIFUGAL FORCE, but by the original impulse, which first gave it motion.

The velocity required in bodies, to produce a continued revolution round others, depends on their distances from those bodies: and the proportion that the distances, and velocities, must bear to each other, is, (by Huygens and Newton,) as the cubes of the distances, to the squares of the times of performing the revolutions.

It is perfectly immaterial how great, or small, the gravitating force may be, or how much matter, or weight, may be contained in the object revolving, or in the body round which it revolves; for the attracting power, (gravitating force) and the detracting power, (centrifugal force) are always in the same ratio to each other.

A sphere, is the only solid figure wherein all the lines produced perpendicularly from every part of its surface, towards its centre, would meet in one point. If the earth were once in a fluid state, and the fluid were compressible in its nature, the centre would become the most dense, and the density would regularly decrease, as we approached the surface. A solid body, of greater specific gravity than the fluid at the surface, would sink in it, and continue to sink towards the centre, until it came in contact with some other solid matter, or the fluid, by compression, became of greater specific gravity than itself. Although the earth, on the foregoing supposition, would not be homogeneous, yet, as the deviation therefrom, would be uniform, it might be so considered, as relates to the intensity of gravitation at different parts of its surface. If the earth, in its fluid state, as above supposed, obtained a rotation on its own axis, a centrifugal force would result, and it would cease to remain spherical, and its deviation from a sphere would depend on the velocity of this rotation. The centrifugal force would be nothing at the poles, and

* The apparent solecism of calling a "force," a "resistance," cannot be avoided. This subject must necessarily abound in them, from the incorrect ideas attached to visible effects.

no effect would be produced; it would be greatest at the equator, but no effect would be produced as to alteration of shape, but only a lessening of the gravitating force; the centrifugal force acting, always, in a direction parallel to the plane of the orbit described by each part of the earth, and at right angles to the polar axis.

The intermediate spaces, between the poles, and equator, would be variously affected by the centrifugal force. In latitude 45, where we will suppose it to produce the greatest effect, the operation would, I apprehend, be as follows. The plumb line, before the existence of this centrifugal force, pointed to a common centre, which was perpendicular to the surface of the earth at that place; and consequently, the fluid was on a level, and had no disposition to change its place. The centrifugal force (being the same, in effect, as an attraction of equal force, in a direction parallel to the plane of the equator, and *from* the earth) alters the plumb line, making the surface, at this place, an inclined plane, declining towards the equator. The fluid flows down this plane, and raises the surface at the equator, and by its removal depresses the surface at the poles.

This is the mode of operation at every point, between the poles and the equator, varying only in degree; and the earth would settle to a form, which should, every where, bring the plumb line perpendicular to its surface; in which situation only, as a fluid body, could it remain at rest.

Now the earth has, at present, a fluid surface to such an extent, or has a fluid communication one part with another, sufficiently free, to prove that it *has* taken such a shape, as to preserve its surface at rest; and from these data, the figure of the earth may be determined. (The tides are not overlooked, but they do not affect the question.)

In my communication to the Franklin Journal for July, on "Falling Bodies," I attempted to prove, that the velocity with which matter obeys gravitation, is in all cases the same, without regard to the degree, or force, of the attraction of gravitation; because "the inertia is always as the gravitating force:" so also, is it, with the centrifugal force.

If the earth, by some means, were to become of double its present weight; say by the addition of an equal quantity of matter, to what it now contains; or, what I contend to be the same thing, that the sun's force of attraction should be doubled; the motion in its orbit would not thereby be changed, for the centrifugal, and gravitating forces, would be in the same relation to each other, as they now are; and so with any of the other planets, or their satellites, in respect to them. If the earth were so far annihilated, that its matter and size, were equal only to that of a pin's-head, it would perform its revolution in the same orbit, as regularly as the earth itself now does, and be no more affected by the disturbing causes of the heavenly bodies, than the earth is.

If, however, we suppose the moon to remain unchanged, the pin's-head-earth, would become a satellite to it, from the alteration of the common centre of gravity between them. We will take no further

notice of the moon in this case, for it is, astronomically, a component part of the earth, and consider the *pin's-head* on "its own bottom."

If, in the revolution of an object round the sun, the attraction of some of the celestial bodies should act on the object, in a direction in opposition to that of the sun, the attraction would not affect the body in its orbit; for it would be the same as a decrease of weight, or of the gravitating force; and the centrifugal force would be decreased in a like ratio. If an attraction from some body, should exist in conjunction with that of the sun, it would only be an increase of weight, and also of centrifugal force, to resist it. If an attraction existed, at a tangent to its orbit, and in the direction of its motion, the *line of attraction* on the object, would not be directly to the centre of the sun, as before, but would be compounded of the sun's attraction, and that of the attracting body; giving a direction, in proportion to their respective attracting forces; or, in the usual phraseology, "as the quantities of matter directly, and the squares of the distances inversely;" and the line of attraction would, slightly, coincide with its motion in its orbit, LESSENING the centrifugal force, (resistance to change of direction) in so far, as its attraction should coincide with the direction of its motion; increasing its velocity and distance from the sun, until as the object revolved, the three bodies should be brought in a line, from which point, to that where the disturbing body should be brought in *opposition* to the motion of the object in its orbit, the operation would be regularly reversed, leaving the object, in plain language, "as it found it." To what extent these disturbing causes might exist, creating eccentricity in orbits, without losing the orbit entirely, is a problem beyond my ability, or inclination, to solve. The actual state of things, is, however, much within this extent.

Hence we see, in the existence of these laws, how admirably the harmony, and security, of the planetary system, are provided for, and how impossible it is, that it should "go wrong."

THOS. W. BAKEWELL.

Cincinnati, July 2d, 1827.

On the subject of Falling Bodies, centrifugal force, and their congeners in philosophy, we are decidedly orthodox; nor do we perceive any thing in the reasoning of our correspondent, calculated, in the slightest degree, to cause us to waver on these points: but whilst we claim the privilege to insert, or reject, any communication, as judgment may dictate, we never shall reject an article, merely because we are not believers in the doctrines which it advocates. It is always understood, that an editor is not to be considered as the advocate of the views of his correspondents, nor ought it, in general, to be expected that he should express his dissent from these views: this, in our estimation, would be to establish a censorship, which would be extremely objectionable. Whilst we claim our own rights, we wish to exhibit the utmost liberality, in construing the rights of others.

What we insert, is open to discussion, and those who write with intelligence, on subjects within the purview of our Journal, may always be heard through the medium of its pages. Editor.

Description of a Steam-engine boiler, adapted to the use of Anthracite, or bituminous coal, and particularly applicable to the Locomotive-engine. By S. H. Long, *Colonel of Topographical Engineers.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir,—Having devoted some attention to the subject of a boiler, or steam generator, adapted to the use of mineral coal, both anthracite and bituminous, as fuel for the steam-engine, and especially for the locomotive-engine, I beg leave to submit the result of my investigations in relation thereto; they are comprised in a brief description of the apparatus proposed for the purposes above mentioned, and illustrated by a drawing hastily executed.

The objects in view, are the construction of a boiler, that shall present the largest surface to the action of the heat, with the smallest quantity of water, and such an arrangement of the fire-place, as will subject the fuel to the strongest draught, and at the same time apply the largest proportion of the heat to the production of steam. The manner in which I propose to accomplish these objects, is as follows.

The accompanying figure, (plate 2, fig. 2,) exhibits a vertical section of the boiler. AA, represents a cylinder of any convenient dimensions, formed of sheet-iron $\frac{3}{16}$ or $\frac{1}{4}$ inch in thickness, rivetted in the usual manner, and constituting the exterior of the boiler. B, the head of the boiler, furnished with a *man-hole* and cap, and also with an aperture, through which the steam is to be conveyed to the working cylinder of the engine. C, a conical frustrum with a concave summit, formed of sheet-iron, of the thickness above mentioned, constituting the interior of the boiler, and at the same time serving as a fire-place. The diameter of its base is about two inches less than that of the cylinder A, while that of the summit is about six inches less, so that the thickness of the circular sheet of water contained in the boiler, is one inch only at the bottom, and about three inches at the top of the frustrum, while the depth above the latter does not exceed three inches. The frustrum and cylinder are firmly connected at bottom, by means of a ring, *a*, of cast-iron or other metal, and rivets passing through them respectively. The ring, *a*, must extend below the cylinder and frustrum, far enough to receive a flanch or step, for the support of the grates, *b*, which are to be adjusted to the circular area of the fire-place.

D, the door, 10 or 12 inches in diameter, through which fuel is to be administered. It is formed by means of a sleeve of sheet-iron, firmly rivetted to the cylinder and frustrum, through the sides of which last, is a corresponding perforation, of the same diameter.

E, the flue, constructed in the same manner as the door, and communicating with the chimney.

The flue may be constructed in such a manner as to pass or wind upon the outside of the cylinder, and apply its heat exteriorly to the boiler, and then communicate with the chimney. The boiler may be sheathed on the outside with pine staves, or any other non-conductor.

The dotted line, *w*, represents the surface of the water in the boiler, the space above serving as *steam-room*. The tube through which the water is conveyed into the boiler, may enter the latter, at any convenient point below the surface *w*.

F, represents a prolongation of the ring *a*, adapted to the use of anthracite, which cannot readily be ignited, in contact with a conductor at a low temperature. The depth of the ring should be about one foot. It must be lined with fire-bricks, or lute of suitable thickness, as represented at *f f*, resting upon the grates *g*, or otherwise supported. The fire-place, in this instance, will be situated below the boiler, and included within the ring F. The whole of the heat that may be generated, must ascend through the boiler, and a large portion of it be applied to the production of steam.

The flanch, or step, for the support of the grates, will be circular, and may be inserted within the ring *a*, and sustained by screw bolts or rivets passing through it and the ring, as represented in the figure.

Any number of boilers of the description above given may readily be combined, and made subservient to the production of steam sufficient for the supply of the most powerful engines.

If we assume three feet for the height of the frustrum, 34 inches for its greatest, and 30 inches for its least diameter, (and three feet for the diameter, and 4 feet for the height of the cylinder A,) the surface exposed to the action of the heat will be about 28 square feet, nearly equal to that of a locomotive engine of the ordinary construction, while the weight of water contained in the boiler, will be less than one third of that required for the common cylindrical boiler.

Very respectfully, &c.

S. H. LONG.

Philad. July 4th, 1827.

Description of an Improvement in Clocks, intended to show the day of the Month. By ALEXANDER YOUNG.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir,—The annexed drawing, represents an improvement in the construction of clocks, by which the day of the month is shown, without the attention that is usually required, to put the hand forward at the end of a short month. After a trial of more than five years, it is found to be a very useful addition, easily made, and ap-

plicable to any clock: if you think it worth publishing, you can give it a place in your Journal.

Yours, respectfully,

Alexander Young.

Camden, S. C., June 20th, 1827.

Description.—Fig. 3, plate 2, represents the improved movement. The wheel of 31 teeth for moving the month-hand is in the usual form, only it has a small wheel of 12 teeth on its side, which makes a revolution in 12 months, by having to pass a fixed pin K, as it is carried round by the month wheel; there are pins on its side at F, A, J, S, and N, which limit the motion of a lever, round a screw or centre at B; there is a pin at G, which limits its motion on the other side. The month wheel is moved by a pin C, projecting from a wheel, which, by the motion of the clock, makes a revolution in 24 hours. There is another pin in the same wheel at D, so short that it will pass under the month wheel. At the end of every month, the lever will come in the way of that pin, and if it be held to its greatest distance from the small wheel, by the pin at F, the lever, and wheel, will be moved round a distance equal to three teeth, and cause the month hand to advance 3 days, as will be required at the end of February; if the lever rest on any of the pins A, J, S, or N, it will be two days later in coming to the pin D, which will cause a motion of only one day; but if the arm of the lever fall between two of the pins, it will be 3 days longer out of the way of the pin D, which will move the lever up to G only, where it will remain until the small wheel has been carried round past the pin K, and moved one tooth, and has begun to rise on the other side, when the lever will fall by its own weight towards the small wheel, until it is stopped by one of its pins, which will make it project as much as is required for that particular month.

The dotted lines represent the lever held in different situations, by the pins in the side of the small wheel.

FOR THE FRANKLIN JOURNAL.

Remarks on the kind of boat most suitable for the transportation of coal, &c., on the Schuylkill navigation, and other canals. By James Stott, *Mineral Surveyor.*

Mr. Editor,

I have lately had occasion to visit Mount Carbon, and could not but notice the very defective manner in which the excellent coal there, is brought down the navigation, to the city of Philadelphia; I see three men and one horse, are generally employed to bring a boat of coal, containing twenty-five tons, along the canal; they do not insist that *all* the hands are wanted, while passing along the canal,

but they do most strenuously insist that *all* the hands are wanted while *passing through the locks, owing to the disproportion between one and the other:* they argue, that it takes the full exertion of two men, to steady the boat, while in the lock, in consequence of the great agitation of the water, and that it would otherwise be materially injured. Now to remedy this inconvenience, I would propose the method used on the late Duke of Bridgewater's canal, from Worsley to Manchester; and likewise upon the Manchester, Bolton, and Bury canal; where the locks are much about the size of those upon the Schuylkill navigation, as shown in the following sketch,* in which the boats are represented passing along the canal, chained together, shoulder to shoulder, one man steering them both; and, likewise, passing the locks, two at once, by which means the lock is so nearly filled, that little room is left for moving about; of course the steersman, or captain, can easily manage them. The gangways, for the captain to step along with his boat hook, and the stages for the horse, while crossing at the dams, are only temporary, and can be removed while loading and unloading. If the lock-keeper happen to be absent, the boy who drives, dismounts, unhitches his horse, assists in shutting, or opening, the gates, letting water into the lock, &c. These boats will carry upwards of twenty tons each, with thirty inches water in the canal, as the following calculation shows. Length of keel 64 feet; deduct 8 feet for cabin ends, leaves 56 feet length; breadth upon the beam, 7 feet 6 inches; allow each boat to draw 4 inches water, (which is double what she will draw,) then 2 feet 2 inches will be left for loading: $56 \times 7\frac{1}{2} \times 2\frac{1}{6}$ gives 910 cubic feet, the content of water displaced by the loading; now one cubic foot of water weighs about $62\frac{1}{2}$ pounds, but call it 60 pounds; then 2 feet will weigh one hundred, *long weight;* of course, 40 feet of water will be a ton; divide 910 by 40, the quotient will be $22\frac{3}{4}$ tons; which proves the above statement to be correct; of course, one man, one boy, and one horse, with two boats, will bring down about 45 tons, long weight, (or 2400 pounds to the ton,) which will save more than half a dollar per ton, on the present system; or rather, it would reduce the price of coal in the city of Philadelphia, and in other cities, as New York, Boston, &c. above 50 cents per ton. If the Schuylkill Canal Company should lower their toll, 50 cents per ton, which they (the acting committee) might well afford to do, considering that 45 tons will be brought down the canal, with less water than 25 can be brought down at present, coal would then be sold at 6 dollars, in the market, with the same profit it now affords, at 7 dollars. The insurance offices might well afford to insure houses, burning stone coal, for one-half the sum they insure for, when burning wood; and this would conduce much to increase

* The drawing referred to, was among those which were lost. It has not yet been recovered, nor has Mr. Stott been in the city, or a new one would have been obtained. The Editor was unwilling further to delay the publication of the paper, as its general merits can be understood without the drawing; but this shall be hereafter supplied.

the demand for it; and, likewise, to quiet the minds of the sick, and the timid, who are now so frequently disturbed by the rattling of engines, and the hoarse voices of the firemen. The boats above recommended, have flat bottoms, and upright sides, they will cost about 150 dollars each, are rather slower in speed, but much more profitable than the boats now in use: they would answer equally well upon the Union Canal, by bringing them two together along that navigation, and passing them singly through the locks, unto Reading, and then passing them along the Schuylkill navigation, as shown in the sketch; it would require from ten to twelve days, to complete a trip with them, from Philadelphia to Mount Carbon. On Canals in Lancashire, England, they have been used for more than twenty years, and found to answer for coal, and rock, in a more profitable manner than any other boats that have yet been devised. They are submitted to your consideration, and to that of the public, by a well wisher to your useful journal, to navigations, and to the coal trade, by

Yours, very respectfully,

JAMES STOTT.

Manayunk, April 21, 1827.

Remarks on a communication on the subject of Mill-Spindles, and Brands, published in a former number of the Franklin Journal.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR,—But for want of leisure, I should sooner have noticed some remarks contained in the Journal, for February last, upon "an improved mill-spindle," which had been described in your number for December, 1826.

From the long experience of William Poole, his testimony in favour of *cast* spindles is of some importance in reference to the fact, that in some parts of our country, though introduced years ago, they are not in general use; wrought spindles being usually preferred, because less liable to fracture, and more easily repaired. To obviate the first objection, cast spindles are commonly made heavier than those of wrought iron, and although the steel toe, and cockhead, have been used to prolong the wear, yet I have known the collars to be worn out in five or six years, (probably because all millers are not so careful as Brandywine millers) and then the spindle became useless, unless by the adoption of one part of my improvement—that of fitting on a separate collar.

The distribution of the metal in the hollow spindle, so as to obtain the greatest strength and stiffness for the weight, I maintain to be of some importance, as well in regard to economy, as to superior performance; objections thereto might be expected from the founder, rather than from the miller; and admitting all that is advanced by William Poole, on the absolute good qualities of a simple, solid, cast iron spindle, I cannot consider his inference correct, that there is little occasion, or room for improvement.

Suppose a water wheel gudgeon with *a neck smoothly turned*, and running on a *composition* ink, should be recommended as most durable, and working with the least friction; many a country miller, and mill-wright, might, and probably would, object and say, "there is no occasion for so much nicety; the improvement if any is 'unnecessary and of small value.' We have long used iron gudgeons with necks rough as cast, and running on inks of the same material; they last a long time, and when worn out, we have only to replace them with others." All this, so far as relates to their experience, would be true, but would form no argument against the superiority of the finished machinery, in the view of those who know its excellence, and it would remain without controversy, that it was not only best, but though doubly expensive at first, the most economical. If I have described a spindle, of materials the most durable, operating with little friction, of the greatest strength and stiffness for its weight, and admitting of repair with facility; do I assume too much in calling it a valuable improvement?

William Poole has obliged us with a description of a cast-iron brand for flour, which may be interesting to those to whom it is a novelty. Such brands have been long used in this neighbourhood, though of late years thrown aside in many of our mills, and cast-iron *stamps* substituted. They are preferred as more convenient and durable, and making a neater *print* on the barrel: they are commonly placed on a block, under the flour-press, with the letters up, like a printer's form; they are then primed, in a similar manner, with printers' ink, and the piece of heading to be marked, is laid, and pressed upon it. I should not have supposed this plan unknown at Brandywine, but for the remarks on brands by William Poole, and I verily believe he will on a fair experiment, allow it to be an improvement, though perhaps of small value.

BELIDOR.

Richmond, Va. June, 1827.

Correction of an error in calculating the mean pressure of elastic steam, in Mr. Perkins' paper on that subject.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR—In the interesting article published by Mr. Perkins, in the last number of your Journal, "on the economy of using highly elastic steam, expansively," I observe a small error in obtaining the mean pressure of the steam on the piston, in the 2nd, 3d and 4th quarters of the stroke. Mr. Perkins supposes, that the mean pressure in the 2nd, 3d and 4th quarters is equal to half the sum of the pressures at the extreme points; but this is not the case, and the error, although not of great practical importance, is an error in science. If we suppose each quarter to be divided into forty equal parts, then the following table will show the pressures, at the respective points of division.

2nd quarter.		*3d quarter.*		*4th quarter.*
41 - 390.24	-	81 - 197.53	-	121 - 132.23
42 - 380.95	-	- 195.12	-	- 131.15
43 - 372.19	-	- 192.77	-	- 130.09
44 - 363.63	-	- 190.48	-	- 129.03
45 - 355.55	-	- 188.24	-	- 128.00
46 - 347.82	-	- 186.05	-	- 126.97
47 - 340.42	-	- 183.91	-	- 125.97
48 - 333.33	-	- 181.81	-	- 125.00
49 - 326.52	-	- 178.65	-	- 124.03
50 - 320.00	-	90 - 177.77	-	130 - 123.07
51 - 313.72	-	- 175.83	-	- 122.14
52 - 307.69	-	- 173.91	-	- 121.21
53 - 301.91	-	- 172.04	-	- 120.30
54 - 296.29	-	- 170.22	-	- 119.40
55 - 290.90	-	- 168.42	-	- 118.52
56 - 285.71	-	- 166.66	-	- 117.64
57 - 280.70	-	- 164.95	-	- 116.78
58 - 275.86	-	- 163.26	-	- 115.93
59 - 271.19	-	- 161.61	-	- 115.10
60 - 266.66	-	100 - 160.00	-	140 - 114.28
61 - 262.29	-	- 158.41	-	- 113.47
62 - 258.06	-	- 156.86	-	- 112.67
63 - 253.95	-	- 155.34	-	- 111.88
64 - 250.00	-	- 153.48	-	- 111.11
65 - 246.15	-	- 152.38	-	- 110.34
66 - 242.44	-	- 150.94	-	- 109.66
67 - 238.80	-	- 149.44	-	- 108.89
68 - 235.29	-	- 148.14	-	- 108.09
69 - 231.88	-	- 146.79	-	- 107.38
70 - 228.55	-	110 - 145.42	-	150 - 106.66
71 - 225.37	-	- 144.14	-	- 105.96
72 - 222.22	-	- 142.85	-	- 105.26
73 - 219.18	-	- 141.58	-	- 104.58
74 - 216.21	-	- 140.35	-	- 103.89
75 - 213.33	-	- 135.13	-	- 103.22
76 - 210.52	-	- 137.93	-	102.57
77 - 207.77	-	- 136.75	-	- 101.90
78 - 205.13	-	- 135.59	-	- 101.30
79 - 202.52	-	- 134.45	-	- 100.63
80 - 200.00	-	120 - 133.33	-	160 - 100.00
Mean, 274.76	-	- 161.81		117.07

From this table it will be seen, that the mean pressure in the 2nd quarter is 274.76 lbs.; in the 3d quarter 161.81 lbs.; and in the 4th quarter 117.07 lbs.; and likewise that the mean pressure for the three quarters is 184.54 lbs.

The method of obtaining these results will occur to the reader. For the first number in the table we have the proportion

41 : 40 : : 400 : 390.24; for the second 42 : 40 : : 400 : 380.95, &c.; or, since the second and third terms are always the same, we may find the numbers, by dividing the product 16000, by 41, 42, 43, &c. respectively, up to 160.

If we desire to know the power of the engine, (for a single stroke,) we have only to add together the numbers 400, 274.76, 161.81. and 117.07, which make 953.64. By comparing this number with the 1000, obtained by Mr. Perkins, it will be seen that his estimate of the power of the engine, is about 5 per cent. too high.

Respecting the utility of Mr. Perkins' engine, it must be left to the usual ordeal of experiment. His discoveries are brilliant, some of them triumphant; and there can be no doubt that his perseverance, and mechanical ingenuity, will eventually lead him to success. Every one who is a friend to public good, and to the promotion of the arts, will sincerely wish him success; and great praise is due to those who have patronized his efforts.

Q.

Description of a new Compensation Pendulum, invented by R. Lee Fearn, M. D. with general observations upon the subject. By the Editor.

The gentleman above named, has presented us with a drawing of an improved compensation pendulum, which is as ingenious as it is simple, and which, it appears to us, will answer well in practice.

We are indebted to that eminent artist, George Graham, for the first application of the principle, which, under various modifications, has been since applied, to preserve unchanged, the centre of oscillation in a pendulum, and thus to insure the performance of all its vibrations, in the same length of time.

When the art of clock-making had attained a high degree of perfection, and the application of this instrument to astronomical observations, rendered the utmost accuracy desirable, it was soon perceived, that the varying length of the pendulum rod, in consequence of its expansion by heat, and contraction by cold, was a source of irregularity, which it was deemed difficult to overcome. Those substances which were found to be least alterable by changes of temperature, such for example as wood, and particularly deal, (pine) were employed, in the best clocks. As the different metals are affected by heat in different degrees, Graham conceived the idea that the greater expansion of one, might be applied to counteract the less expansion in another. After a series of trials, during a period of five or six years, he succeeded perfectly, by attaching to the pendulum rod, a vessel containing mercury, which liquid, when the rod was expanded by heat, rose, from the same cause, in the vessel which contained it, so as to compensate for the downward expansion of the rod. This improvement was completed in the year 1721. Five years afterwards, John Harrison, a carpenter, of Barton, in Lincolnshire, subsequently so celebrated for his improvements in

chronometers, invented, and applied to a clock of his own manufacture, the pendulum, which, from its form, is called the gridiron-pendulum. In this, the expansion of the iron rod, is corrected by the greater expansion of rods of brass, or of zinc, which tend to raise the bob, in the same degree in which the expansion of the main rod, tends to lower it; and it, of course, is retained in the same place. In this form, the compensation pendulum is, to the present day, most commonly made. The principle upon which these pendulums were constructed, has received various modifications in the hands of different artists: the rods of Harrison's, for example, instead of being arranged in the form of a gridiron, have been enclosed in a tube, and greater elegance and compactness, with a more easy mode of adjustment, have been attained: these, however, we believe, comprise the whole merit of the modern improvements.

Figure 1, plate 2, represents the mode of compensation, proposed by Dr. Fearn. A is the pendulum rod, suspended by a flexible spring, in the usual manner, from the cock B. C is a rod, or bar, of zinc, attached to the back plate of the clock, by a screw at its lower end. The head, D, of this bar, works upon a pin, which forms a joint, as represented in the drawing. Through this head, there is a mortice, which allows one end of the lever, E E, to pass through it, and within which, it may be fixed firmly, by means of a tightning screw. The lever E E, is attached to the clock plate by a screw, which is also its fulcrum. Through a slot, in the inner end of this lever, the suspending spring passes, and is closely embraced by it, on its lower side.

The operation of this apparatus, will readily be perceived; as the rod A lengthens by heat, or contracts by cold, the rod C, will be similarly affected. The expansion of C, will cause the inner end of the lever to descend, and, consequently, to embrace the suspending spring, at a lower point, and thus to diminish the effective length of the pendulum. The mode of adjustment is obvious, as a greater, or lesser motion may be given to the lever, the upper end of the rod C, being made to approach, or recede from its fulcrum. To obtain the requisite accuracy, an adjusting screw, may be made to act upon the head D.

We are aware that the clock plate will expand, when the rods of iron, and of zinc, undergo that change, but the superior expansion of the zinc, will still render the attainment of the compensation, perfectly easy.

The inventor has proposed some other modifications of the same principle, but as we deem the one represented, the best, we present it, alone, leaving the variations, and the details, to the judgment of the practical mechanic.

FRANKLIN INSTITUTE.

FOURTEENTH QUARTERLY REPORT.

At a special meeting of the Franklin Institute, held at their Hall on the 23d July, 1827, the following Report of the Board of Managers, was read, and accepted.

Philadelphia, July 19th, 1827.

The Board of Managers of the Franklin Institute, in obedience to the laws of the Institution, present to the general meeting their Fourteenth Quarterly Report.

Although the present, is not the season for the more public operations of the Institute, the Board have been occupied in devising such measures, as experience has proved to be requisite, to ensure the beneficial prosecution of the objects of its formation; the utility of which, they confidently hope will be fully manifested, at the approaching period for the delivery of the public Lectures, and the opening of the drawing school.

In the last Report of the Board, it was stated, that experience had shown, the necessity of regulating the attendance of minors, in the Lecture room; much inconvenience having resulted from the disorderly conduct of some of those who have been heretofore admitted. In conformity with these views, the Board have adopted the following regulations.

Tickets admitting youths to the Lectures shall not be issued, excepting their parents, guardians, or masters, will certify, that they are, at least, sixteen years of age.

Seats are to be designated for such youths, and should they refuse to occupy them, their tickets shall be forfeited.

They shall not be permitted to enter the room, after a Lecture has commenced.

The tickets of those youths, who are guilty of improper conduct, in, or near, the Lecture room, so as to disturb the Lecturer, or the company attending, shall be forfeited.

As there are many youths under the designated age, whose deportment would be perfectly decorous, and who would derive advantage from attending the Lectures, the Board have resolved, that where a parent, guardian, or master, will give an assurance that he will accompany, and keep by him, any youth who has not attained the age of sixteen, the Treasurer may issue a ticket to such person, with such a conspicuous mark thereon, as shall enable the doorkeeper, at once, to see its purport. But separate tickets, are not to be issued, for such youths.

It has also been determined, that the Hall of the Institute, shall not, hereafter, be let, or granted, for the use of meetings for political, or religious discussions. For, although the Hall, when let for public purposes, is out of the hands of the Institute, and it is not therefore, a party, in any such discussions, it has been found, that the mere permission thereof, has had an unfavourable influence,

upon the public mind; and it has consequently been deemed proper to restrict the use of the Hall, to purposes purely literary, scientific, or beneficent.

Measures are in train, under the superintendence of the Library Committee, which it is believed will tend to the increase of the library, and to its active usefulness.

The High School of the Institute has continued in a flourishing condition. The first examination of the pupils has just commenced, and it is expected, will justify the anticipations of its patrons.

The Board have great pleasure in stating, that the Franklin Journal, published under the auspices of the Institute, has obtained a very extensive circulation; and that there is therefore no doubt whatever of its permanence.

The Institute has already been informed, that it was the intention of the Treasurer, John Richardson, who has so ably and faithfully performed the duties of that office, to retire. His last report is herewith presented. Mr. Samuel V. Merrick has consented to serve, in his place, during the remainder of the year.

The Report of the Treasurer, it will be seen, exhibits a deficit of $116 32. This has arisen from the change made in the time of the annual payment from members, which was formerly received on the 1st of January, but is now, payable on the 1st of October; this deficiency is, therefore, to be considered as a temporary result of that arrangement.

By order of the Board of Managers,
HENRY TROTH, *Chairman.*

THOMAS P. JONES, *Secretary.*

Report of the Committee of Inventions of the Franklin Institute, on a Wind-mill with vertical sails, invented by M. Biard, of Paris, and by him denominated the Anémotrope.

THE Committee of Inventions having carefully examined the model of the Anémotrope, together with a printed memoir on the subject, containing a description, and engravings of the sails and their appendages, which the inventor, M. Biard, of Paris, in the kingdom of France, has presented to the Institute, report:

That the novelty in the proposed windmill, consists in the manner in which the sails are disposed, and affixed to the shaft; and that in these particulars, it differs materially from the horizontal windmill most commonly used in this country. A vertical shaft, connected with the machinery to be operated upon, is made to extend above the mill-house, and is to be carried round by the action of the sails. There are four pair of sails, each pair being attached to a piece of timber which is to cross the vertical shaft, at right angles; there are, of course, four of these pieces of timber, each of sufficient length to receive two sails, and to allow the requisite distance, between their inner extremities; by which intermediate part, these timbers with their sails, are to be hinged to the vertical shaft.

The pairs of sails, are so nailed, or screwed, to the extremities of

the timbers, which form their arms, that their planes cross each other at right angles. Upon the vertical shaft, at a distance from each other, about equal to the width of the sails, there are four short transverse pieces of square scantling, firmly attached, for the purpose of sustaining the timbers which form the arms of the sails, and which are to be hinged to them. A bird's eye view, of the vertical shaft, would present the projecting ends of these short pieces, as forming with each other, an angle of 45 degrees. The timbers or arms, are so hinged to the transverse pieces, that the sails which they carry, will, when not acted upon by the wind, each form an angle of 45 degrees with the horizon; but when receiving the full force of the wind, they will turn so as to expose one sail to its action, whilst the other, standing in the plane of the horizon, will not feel its influence. From this arrangement of the sails, it results, that whatever may be the course of the wind, the shaft will still be turned in the same direction, and the sails will always be acted upon, with a force proportioned to its intensity.

In all mechanical inventions, the test of experiment, and that upon a scale which shall exhibit the actual operation of the machine, is necessary, before we attempt to pass a final judgment in its favour. In the present case, the model operates perfectly well, and is affected by a very light breeze. The simplicity of the structure, can scarcely be surpassed, which in mechanical contrivances, where utility is not sacrificed, is no small praise; and this does not appear to be the case in the present instance.

There is not any provision made for contracting the sails, in case of increased intensity in the wind; this, however, may be accomplished, with the same facility as in the ordinary wind-mill.

In its mode of operation, this bears a considerable resemblance to some other horizontal mills, but particularly to that of Beatson, which was patented, in England, in the year 1797; the arrangement of the sails in M. Biard's, however, appears preferable to Beatson's; but still, it is a fact, that, the horizontal mill, in any of the forms hitherto tried, is inferior in its action to the vertical, although it may, under certain circumstances be preferred to it. In estimating the merits of any horizontal mill, it ought, therefore, to be compared with other horizontal mills, and not with the best upon the old construction.

The Committee have annexed a drawing of M. Biard's mill, with references to explain its action.

Philadelphia, April 4th, 1827.

Attest, THOMAS P. JONES, *Secretary.*

Figs. 4 and 5, plate 2, are drawings of M. Biard's mill.

A, A, Fig. 4, the upright shaft.

a, *b*, *c*, *d*, *e*, *f*, *g*, *h*, the sails upon their respective arms.

d, is in full action, whilst its fellow, *h*, is turned edgewise to the wind.

c, has passed beyond the point of full action, and

b, and *f*, present their ends to the wind, whilst
a, is just coming into action.

i, Fig. 5, is a section of one of the transverse pieces upon the shaft, and *k*, of one of the arms to which the sails are attached: this latter is hinged by one of its angles to *i*, which admits of its turning so as to bring the sails, represented by the dotted lines, alternately, into a horizontal, and vertical position.

l, is a rod and ball of metal intended to balance the sails, so that when out of action, they may rest in the position represented by the dotted lines. This balance may be seen on the arms in fig. 4, and its use is evident, on inspecting fig. 5, the hinge being on one side of the piece carrying the sails.

Remarks upon the properties essential in good gunpowder, and upon the methods of testing its strength. *By* Joshua Shaw, Esq.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—Being a constant reader of your Journal, and always interested in new discoveries and improvements, my attention was arrested by an article in your last number, on the strength of American gunpowder. The subject is one of which I may claim some knowledge, from a practice of more than thirty years, in the sports of the field; and from having myself performed numerous experiments in relation to it, and paid much attention to the experiments and opinions of others.

Although I differ, in some points, with captain Baird, and with the writer of the "Manual," we all agree, that powder to be good, should be quick, strong, free from impurity, and not liable to attract moisture from the atmosphere. In the article alluded to, it is said, that "several methods for proving, or trying, the strength of powder, have been adopted, but with the exception, perhaps, of Mr. Dupont's eprovette, none of them can be relied on for much accuracy." Now, in my opinion, this eprovette is equally defective with those usually employed, and which I consider as worse than useless. Their great fault is, that a similar result may be obtained by them from powder which is strong, and from such as is comparatively weak, but which excels the former in quickness.

The real strength of powder depends upon the quantity of gas resulting from its explosion: the coarser kinds frequently yield more than the finer; every experienced sportsman knows, that with coarse powder, he can kill wild-fowl at a greater distance than he can with the best cannister, although the measure of both be the same, yet, in this case, the weight of the fine will exceed that of the coarse. The blow upon the shoulder, it is true, will be most powerful from the fine, that from the coarse being scarcely felt; the cause of this is, the coarse burns with comparative slowness, and giving out a large volume of gas, the elastic force increases, until the shot leaves the muzzle of the gun; whilst that which is fine, being generally quicker, has every grain ignited at nearly the same moment, and exerts a sud-

den force, which is felt like the blow of a hammer; but this force does not continue, but relaxing before the shot is discharged, these latter are retarded by friction, and pass on with decreased velocity. A little reflection will make it apparent, that the quickest, and not always the strongest, powder will tell best, either in the eprovette described, or those referred to in the article in question. It is true, that the quickest powder may also be the strongest, but the test given is fallacious, and is calculated to lead into error; besides which, were the means good, but few persons could avail themselves of them, as they have no instrument at their command. I will therefore describe the mode which I have followed, and which can be practised by every man who has a gun; but I will first add a few words upon the properties of powder.

In field sports, the percussion gun has effected a considerable revolution; having caused such powder to be preferred, as was formerly rejected. Strength, not quickness, is now the important point, because the fulminating powder used for priming these guns, distributes the fire with the quickness of lightning, throughout the whole charge, and at once ignites every grain, thus rendering what, in the old gun, was slow powder, many times more rapid in its combustion, than the quickest powder formerly was. A quick powder is rendered so much more so, when ignited in this way, as to resemble, in its action, some of the fulminating powders, and consequently to endanger the bursting of the gun. The English manufacturers are evidently aware of this effect, as is evident in a number of fine guns lately imported by Mr. Constable, of this city: they are thickened near the breech, whilst they are kept as light as usual, by lessening their thickness in other parts where the metal might safely be spared.

The effect of a too rapid explosion may be illustrated by the action of the fulminating powders, of which there are several kinds. A small charge of these will burst the strongest fowling piece, but will not throw a ball ten paces. Although strength is always an important point, I think that it must now be manifest, that it is dangerous to confound this property, and quickness, with each other.

Impure or dirty powder is the detestation of every sportsman, as it is a fault without remedy. If his powder be weak, he may add to his charge, and obviate this evil. I have freely used the Brandywine powder, and also Pegou's, and have consulted with many of my friends, who have also used both; all have agreed that the Brandywine is both strongest and quickest; but all have also agreed that it is much less cleanly, soiling the gun more than Pegou's, and giving to water, in which the barrel is washed, an ink-like appearance, whilst a grayish tint only is produced by the latter, without much injuring the transparency of the fluid.

Had captain Baird tested the powder intended for ordonance, he would have probably found that the English manufactured article is not yet equalled by that made in this country. This, at all events, was the case with a quantity found on board the Lady Johnson, captured during the last war, on her voyage to Canada. The fact rests on the testimony of every one who had an opportunity

of trying it. This is a point of great importance, and well worthy the attention of the government, and of the manufacturers of the article.

I will now describe the mode which I have adopted in testing the *strength* of gunpowder. The machinery which I employ, may not be very scientific, but it is, nevertheless, certain, and uniform, in its results. I place a piece of board, vertically, with a hole in it, of from six to eight inches in diameter, over which I nail a quire of paper, by the two upper corners; the sheets are compact, as taken from the ream: writing paper is to be preferred. This is my target, at which I fire from a distance of thirty or thirty-five yards. My shot is weighed, and the powder measured, with some care; and before firing at the target, I turn up six or eight leaves of paper, placing over them a loose board, to protect them from the shot. I then fire, say No. 6 shot, and if the powder be strong, many of the pellets will pass entirely through the paper: if more than half pass through, I turn down some of the sheets, and thus proceed until it is perforated by about one-half of the number discharged. Other kinds of powder may now be compared with that first used; one, may not cause a single pellet to pass through, whilst from another, the whole charge will pass; by increasing or decreasing the number of sheets, you may find a difference of twenty per cent, and that, in favour, sometimes, of powder which appeared the weakest by the common eprovette. The correspondence between this mode and the practical use of powder, is apparent; and experience has proved it to be the best.

The trial, by firing powder on white paper, is altogether fallacious; some kinds not soiling it, which yet are absolutely filthy, when used in the gun; and some burning quickly in the loose heap, which are slow when rammed down.

I trust I have proved, that quickness is a property in powder, much less durable than formerly; and that elastic force, and purity, are the main requisites.

Should you sir, however, wish for further evidence upon this point, it will afford me pleasure to furnish you with my mode of testing the quickness of powder, which measures the time required to burn different kinds of powder with such accuracy, that in numerous trials the difference in the results will be a mere fraction.

In offering these views, I have not been prompted by any invidious motive; my aim has been to ascertain the truth; in two out of three of the main points, I have confirmed the statements of captain Baird, although in some minor particulars we have not agreed. I am not an adept at writing, but having had much practice, in the use of gunpowder, I have attempted to describe what I have actually observed; and if I have succeeded in making known any thing which may have escaped the notice of others, my observations will possess some value.

Very respectfully yours,

Joshua Shaw.

Philadelphia, July 18th, 1827.

ON JAPANNING AND VARNISHING.—No. 6.

FROM CORRESPONDENTS.

We resume this subject, after a long interval, and present two communications, appertaining to this department; one of which we some time since promised to our readers; and both of them will be found to be valuable. We expect some other processes, and recipes, which have been long promised, by a gentleman able to give us much aid.

It has been a great desideratum among artists, to render shellac colourless, as, with the exception of its dark brown hue, it possesses all the properties essential to a good spirit varnish, in a higher degree than either of the other resins. A premium of a gold medal, or thirty guineas, "For a varnish made from shell, or seed lac, equally hard, and as fit for use in the arts, as that at present prepared from the above substances, but deprived of its colouring matter," has long been, and is still offered, by the Society, in London, for the encouragement of Arts, Manufactures, and Commerce. These ends are perfectly attained, by the process given by Dr. Hare, which leaves nothing to desire, excepting on the score of economy. Were the oxymuriate of potash, to be manufactured in the large way, the two processes, that of making the salt, and of bleaching the resin, might be very advantageously combined.

Method of bleaching shell, or seed lac. By R. Hare, M. D.

Dissolve, in an iron kettle, one part of pearlash, in about eight parts of water, add one part of shell, or seed, lac, and heat the whole to ebullition. When the lac is dissolved, cool the solution, and impregnate it with chlorine, till the lac is all precipitated.

The precipitate is white, but its colour deepens by washing and consolidation; dissolved in alcohol, lac, bleached by the process abovementioned, yields a varnish, which is as free from colour, as any copal varnish. R. H.

Chlorine, or oxymuriatic acid, may be formed, by mixing, intimately, eight parts of common salt, and three of the black oxide of manganese, in powder. This mixture is to be put into a retort; four parts of sulphuric acid, diluted with an equal weight of water, and afterwards allowed to cool, is to be poured upon the salt and manganese, when the gas will immediately be liberated, and the operation must be quickened, by a moderate heat. If the mixture be made, without the sulphuric acid, and this be added, in small portions, the heat generated by this means, will be sufficient to disengage the gas, without the aid of a lamp. A tube leading from the mouth of the retort, must be passed into the resinous solution, when the gas will be absorbed, and the lac precipitated.

On the preparation and use, of a Mastic Varnish, particularly suitable for Paintings in Oil. By Joshua Shaw, Esq.

TO THE EDITOR.

Sir—Amateurs, and collectors of paintings, are frequently at a loss for a varnish properly prepared, and suited, for the purpose of

restoring and preserving the colours, in works of art. I submit the following observations on the preparation of a very good one, and the best mode of applying it to the surface of pictures painted in oil.

Experience has shown, that for this purpose, mastic varnish is in general, preferable to any other, especially in the hands of inexperienced persons, and, with but few exceptions, even in those of the adept. This varnish is generally prepared, by dissolving the mastic in spirits of turpentine, over a sand heat, in a well glazed earthen, or in a copper vessel, occasionally shaking, or stirring it about, until entirely dissolved, which will take place before it arrives at a boiling heat; after which, it is strained through a piece of calico, in preference to linen, as it is less apt to give off lint, which is very troublesome when it gets into the varnish: it is then put into a bottle, well corked, and placed for two or three weeks where the light of the sun can strike it, which will cause a large precipitation of mucilaginous matter, and render it as transparent as water. It is now to be decanted off into a clean bottle, and put by for use. This is the mode of preparing that commonly sold in the shops; but to insure a varnish that can be depended upon, the following observations must be attended to. Let all the mastic be bruised by a muller on a painter's grinding stone, which will immediately detect the soft, or oily tears, which must be rejected; as when dissolved in the mass, they prevent the varnish from drying hard, leaving a greasy, or tacky surface. The next point of importance, is to procure, if possible, turpentine which has been distilled a second time; but, where this is not to be had, the best kind sold in the shops must be taken; but it must be perfectly clear and colourless, otherwise, good varnish cannot be obtained; it must not be furnished through an oily measure, (which is but too commonly the practice) but poured out of the carboy without shaking or disturbing it. If any doubts are entertained as to its purity, put about two table spoonfuls into a common white saucer, and let it evaporate in the sun, which will be effected in two or three hours; and if it leave a greasy residuum, or a soft sticky mucus, it must be rejected; that only is good, which entirely disappears. Thus prepared with good spirits of turpentine, and with mastic bruised and picked, the two ingredients may be put into a clean bottle, when the resin may be dissolved without heat, by half an hour's shaking in the hand; it must then be strained, and afterwards treated as before recommended.

The French sometimes prepare this gum in spirits of wine, (pure alcohol) but it is subject to chill on the picture, and produces, in time, a kind of white scale over it, which injures its lustre.

When it is prepared after the manner recommended, six ounces of pounded gum, are mixed with fourteen ounces of pure spirit of turpentine, which may, if found too thick, be diluted with more turpentine. It should be laid on with a soft, flat, camel's hair brush, as it is called, but which however, is made of the hair obtained from the squirrel's tail. The varnish should always be laid on with as much despatch as possible, keeping it alive, as the artists term it, and floating after the brush. It may be proper to observe, that no kind of

varnish should be applied to any painting, without first cleaning it; nor to a newly painted picture until it is perfectly hard, to effect which, requires five or six months. Before varnishing, be careful to remove all grease from the surface, by a coat of whiting, (not lime) dissolved in water, and laid on so that it covers, and entirely obscures the picture; this should be allowed to dry, and to remain on for one or two hours, when it must be entirely removed by a sponge and some clean rain water; then perform the operation of varnishing in a still room, free from lint and dust.

It will sometimes happen, that a picture, where the surface is smooth, will look too bright and glaring, which is both disagreeable to the eye, and injurious to the effect of the picture: to remedy this defect, after the varnish is quite dry, say in ten or fifteen days, sponge the picture all over with pure rain water, for about one or two minutes; and having squeezed the sponge, and made the picture as dry as the sponge will leave it, pass, lightly, a clean silk handkerchief over it, with great rapidity, until it become perfectly dry; when a clear, steady, lucid, appearance, will pervade the whole picture. Breathing occasionally on the picture to damp it, will assist the operation, while chafing it with the handkerchief.

Yours, very respectfully,

Joshua Shaw.

Philadelphia, July 12th, 1827.

On the Saccharum of the sweet potato, (convolvulus battatas) as a substitute for malt, in the preparation of beer, and for other purposes. By Robert Hare, M. D. *Professor of Chemistry in the University of Pennsylvania.**

Dr. Tidyman, of South Carolina, lately supplied me with some sweet potatos, of a kind in which the sweet matter is peculiarly abundant, and requested that I would ascertain if there were any sugar in them. Having pared, and, by means of the instrument used for slicing cabbages or cucumbers, reduced them to very thin slices, about a pound was boiled in alcohol of the specific gravity of .845, which appeared to extract all the sweetness, yet on cooling yielded no crystals of sugar. The solution being subjected to distillation, till the alcohol was removed, an uncrystallizable sirop remained. In like manner, when aqueous infusions of the potatos were concentrated, by boiling or evaporation, the residual sirop was uncrystallizable. It appears, therefore, that the sweet matter of this vegetable is analogous to molasses, or to the saccharum of malt.

Its resemblance to the latter was so remarkable, that I was led to boil a wort, made from the potatos, of proper spissitude, say s. g. 1060, with a due quantity of hops, for about two hours.

* Communicated, originally, to the Agricultural Society of the State of Pennsylvania.

It was then cooled to about 65 degrees, and yest was added. As far as I could judge, the phenomena of the fermentation, and the resulting liquor, were precisely the same as if malt had been used. The wort was kept in a warm place until the temperature 85 F. and the fall of the head, showed the attenuation to be sufficient.* Yest subsequently rose, which was removed by a spoon. By refrigeration a further quantity of yest precipitated, from which the liquor being decanted, became tolerably fine, for new beer, and in flavour, exactly like ale made from malt.

I have computed that five bushels of potatos, would produce as much wort as three bushels of malt; but I suppose that the residue would, as food for cattle, be worth half as much as the potatos employed.

I believe it possible to make as good liquor from malt in this country, as in England, but that in our climate much more vigilance is required to have it invariably good; principally, because the great and sudden changes of temperature, render malting much more precarious. Should the saccharum of the sweet potato, prove to be a competent substitute for that of germinated grain, the quality will probably be less variable, since its development requires but little skill and vigilance. Besides, as it exists naturally in the plant, it may be had where it would be almost impossible to make, or procure malt. Hops, the other material for beer, require only picking and drying to perfect them for use. They are indigenous in the United States, and may no doubt be raised in any part of our territory.

I have dried, in my evaporating oven, some of the sweet potatos in slices. It seems to me, that in this state, they will keep a long while, and may be useful in making leaven for bread. They may take the place of the malt necessary, in a certain proportion, to render distiller's wash fermentable. The yest yielded by the potato beer, appeared in odour and flavour, to resemble that from malt beer surprisingly, and the quantity, in proportion, was as great. In raising bread it was found equally efficacious.

I propose the word *suavin*, from the Latin suavis, sweet, to distinguish the sirop of the sweet potato. The same word might, perhaps, be advantageously applied as a generic appellation to molasses, and the uncrystallizable sugar of grapes, of honey, and of malt.

Crystallizable sugar might be termed *saccharin*, since the terminating syllable of saccharum, is appropriated, in chemistry, to metals.

* In passing to this state, there should be a loss in gravity of about 4 per cent.

Some account of the Hot Springs, in Bath county, Virginia, in a letter to the Editor, from P. A. Browne, Esq.

Hot Springs, Bath county, Va. 1st July, 1827.

Dear Sir,

If you have been surprised to learn, from my former letters, the variety of waters at "Warm Spring," you will be much more so with their enumeration at this place, all of them lying within the circuit of a few hundred feet. There is a fine spring of very cold water, which does not appear to partake of any mineral qualities. There is another not quite so low in temperature, but which, being more copious, is conveyed to the house, through logs, and used for drinking and culinary purposes. From underneath a small ledge of rock, proceed two springs, one very cold, and the other moderately warm; these mingle their waters together. Just above their point of junction, you may, at the same time, immerse one hand in *warm*, and the other in *cold* water. There is a spring of warm water, which I am assured, (except in point of temperature,) resembles the celebrated water of the "Sweet Springs." There is a small spring of limestone water. There is a very copious spring of water, at the temperature of 96, which is covered with a house, and termed the "Moderate Bath." Another, called "the *Spout*," at the heat of 103°; and lastly, "the Boiler," which flows at the high temperature of 107°. The Spout, is so called, from the circumstance of the water being, in part, conveyed through a log, from the end of which, rheumatic, and other patients, allow it to fall upon the part affected.

The scenery here is grand, and the views from the summits of the surrounding hills, commanding. I have scarcely ever seen a place for which nature had done so much, and man had done so little. The land was taken up in two tracts, which are divided by a creek; each owner possessing an equal right to the springs. One parcel is owned by the widow, and two grand children of the gentleman who formerly kept the boarding house; they lease it to the present occupant, from year to year; the tenant, of course, feels no great inducement to improve it. The house is very much out of repair, and the whole establishment bears the appearance of being neglected. The other tract is owned by a gentleman who is far advanced in years, and who, being opulent, will not, in all probability, improve it. It is to be regretted, that the whole could not fall into the hands of some gentleman of fortune and taste, who would embellish it; with the expenditure of a few thousand dollars, it might be made not only the most beautiful, but also the most useful watering place in Virginia; possessing, as it does, the superior advantage of variety, in the waters. The cures that have been effected, by the use of the *Boiler*, are almost incredible. It is no uncommon occurrence to see persons, afflicted with rheumatic complaints, come hither on crutches, and to find them, in two or three weeks, entirely restored. There have been instances of persons brought on a litter, and riding home on horseback. There is a gentleman, now here,

who had nearly lost the use of his right arm; the veins had sunk into the flesh, so as scarcely to be visible; the limb had diminished in size, and was as cold as death. When he arrived at the Hot Springs, he had not had regular sleep for upwards of three months; night after night he had paced his chamber in agony, not pretending to take off his clothes, and catching only a few moments repose, while lying on his stomach, across the foot of the bed. The night after he had taken the first bath in the Boiler, he slept soundly, from ten o'clock till breakfast time. His arm has resumed its temperature; the veins are filled, and the pain has so much diminished, that I make no doubt, but in a month's time, he will be entirely well.

The heat of the water is probably occasioned by the decomposition of the sulphurate of iron, with which this valley abounds, and immense quantities of which, no doubt, exist in the mountain. Streams of water passing through these beds of pyrites, produce decomposition, caloric is disengaged, and the water is, at the same time, saturated with sulphuretted hydrogen gas. About five miles below this place, upon the farm of Mr. Stonestreet, is a spring, similar, in some respects, to those at this place, on the banks of which you may procure sulphate of iron, in large quantities. The water of the Hot Spring contains, also, a portion of lime, which it deposites, in minute concretions, wherever it has an opportunity of evaporating, and is to be found in the form of a calcareous tufa, along the banks of the creek. The stream supplied from the various springs, is, at the distance of less than half a mile from their sources, capable of turning a mill. On the western side of the town is a mountain which, by way of distinction, is called "the Little Mountain," though its height is very little inferior to the Warm Spring mountain. Its rise is upon an angle of about 45°; its assent is difficult, on account of the immense number of loose stones with which the ground is completely covered. I was induced to ascend to the very top, and although it was a warm and toilsome task, I did not regret it. I collected some very fine specimens of ferruginous sand stones, with animal and vegetable impressions; and I had an opportunity of viewing a complete wall of sand stone rocks, as regularly piled, one upon another, as if done by a mason, and which extended the whole distance of my journey.

Yours truly,

P. A. Browne.

Dr. T. P. Jones.

ESSAYS ON LITHOGRAPHY.—No. II.

Ink for Writing, or Drawing, on stone, or on Autographic Paper.

The principal operation in lithography, consists in impregnating a stone with fatty substances, very superficially, so that, in consequence of the affinity which exists between these substances, and their power to repel water, the points, or lines formed with them on stone, shall be capable of retaining other such substances when-

ever they are brought in contact with them; while these same substances, will be repelled by the moisture which the stone has imbibed in those parts which they do not cover. Thus, when lines have been made on a stone, with lithographic ink, or crayons, into the composition of which fatty bodies enter, and afterwards a roller charged with a fat or oily ink, be passed over these stones, this ink will be deposited on the traces of the crayon, or of the lithographic ink, in a thin layer, but sufficient to produce an impression; whilst it will not adhere to any parts of the stone, which are not impregnated with the fatty matter, and which, besides, are kept in a moist state. It is on this point, that all the art of lithography depends; and it is only requisite, therefore, to discover what substances, by a proper combination, can be made most suitable to answer the double purpose of producing a good drawing, and of receiving the ink, which is to form the impression. It will be apparent, that it is not a matter of indifference what kind of fatty substance be used, with which to form a drawing, or to trace a writing, on the stone. These substances, in their natural state, if brought into contact with a stone, would diffuse themselves in every direction, and, consequently, would not be capable of forming points, or lines, sufficiently fine, and well-defined, to give to a drawing, the delicacy, precision and harmony, which it ought to have. It is necessary, then, to find a liquid composition, by which may be traced, lines as clear and well-defined, as those made on paper with Indian ink, and also a solid preparation, which will produce the same results as the common crayons, used by artists. Hitherto, it has only been possible to effect this, by forming a kind of soap, by the combination of fatty or resinous substances, with an alkali. This soap, when liquid, does not spread, as do grease and oils; and when in a solid state, it has such a degree of consistency as to enable the artist to produce on stone, all the effects of a drawing. But as soapy bodies are, in general, soluble in water, and as the water with which it is necessary to moisten the stone, and consequently the drawing, before applying the printing ink, would destroy the drawing, by dissolving the soapy substance with which it was formed, it was necessary to find a means of reducing this soap to the state of a fatty body, insoluble in water. This is effected by spreading over the stone, and over the drawing, an acid, which, by uniting with the alkali of the soap, reduces the latter to the state of grease. This operation, of which we shall say more hereafter, is called *the preparation.*

Lithographic ink, if good, will be soluble in distilled water, and in all spring, or river water, which is capable of perfectly dissolving common soap. It ought to flow freely from the pen, and not spread on the stone; it must also be capable of forming extremely fine lines, and should be very black, in order to render the work of the artist perfectly clear, and distinct. The most essential quality, however, is that of imbedding itself firmly in the stone, so as to reproduce the most delicate touches of the drawing, and to afford a great number of impressions; in order to this, it is necessary that it should be

capable of resisting the acid which is spread over it in the *preparation* so as not to have its fatty particles either removed, or altered.

A host of recipes for making lithographic ink and crayons, have been published, and scattered, both in Germany, and in France. M. Senefelder, in his work, gives eight receipts for making this drawing ink; yet, assuredly, he has not published that which he considers the best. We think it superfluous to give these receipts, as it would only serve to create uncertainty in choosing from among them, and especially as we consider them all, more or less, inferior to that which we have used for a long time. and with uniform success. It was after having tried a great number of compositions, that we gave the preference to the following.

Lithographic Ink.

Soap, from suet, or tallow,—dry, . . .	30	drachms.
Mastic in tears, ...	30	do.
Soda, of commerce, ...	30	do.
Shellac, in plates, ...	150	do.
Fine lamp black, ...	12	do.

Soap made of tallow, is to be preferred to that prepared from oil. But as soap is more or less hard according to its age, and the dryness of the situation in which it has been kept, it must not be used in exactly the above proportions with the other articles, without regard to its being either moist, or dry. To obviate this source of error, and to obtain the exact proportions, the soap should be cut with a knife, into thin slices, and exposed to the sun and air, until it is perfectly dry; it is then to be put into a box lined with paper, and thus kept, in a very dry place, until it is wanted for use. The best lamp black, which is the product of the combustion of rosin, should be used.

In order to melt these materials, a copper, or cast metal skillet should be used, which should be furnished with a wooden handle; it will also be found convenient for it to have a lip on its edge, in order that the material may pass more readily into the moulds; particularly when crayons are to be made. The soap is first put into this vessel, which is then to be placed over a brisk fire in a chafing-dish; when this is well melted, the shellac is to be thrown in, which will fuse very readily; the soda is then to be added a little at a time, and after this, the mastic, taking care to stir it with a spatula furnished with a wooden handle; lastly, the lamp black is gradually put in, stirring it between every successive addition, until the mixture is complete. A very brisk fire is used, that the materials may be perfectly fused. The shellac is apt to swell up; it is, therefore, put into the skillet gradually, that it may not boil over. When all these materials are well incorporated, they are poured out on a plate of cast iron, made very warm, and rubbed over with oil, in order that the composition may be easily detached from it. Before the mass is poured upon the plate, ledges are formed around it, with pieces of wood, which serve to prevent the mass from running off, and enables us to preserve it of an equal thickness throughout; when these pieces are removed, the composition is to be cut into strips,

by means of a knife, which should be guided by a rule; this must be done whilst the material is warm. Little sticks are thus formed, similar to those of Indian ink: it would, however, be more convenient to have moulds, in which to pour the composition.

Many who have written on the subject of lithography, have recommended, not merely the melting, but the partial burning of the materials, with which lithographic ink and crayons are to be composed; but this is a bad method, since it is impossible, in this way, always to obtain the same combinations; as some portion of the materials would thus be wholly destroyed. The means of obtaining good ink, must depend on the nature of the materials, and upon their being duly proportioned to each other; and to accomplish these ends, it is not necessary to have recourse to combustion.

The ink of which we are about to give the composition, is used either with the pen, or the camel's hair pencil, for writings, dotted, and aquatinta drawings, those of a mixed character, or those intended as imitations of wood, or other engravings.

Autographic Ink.

We proceed to describe, practically, the process for preparing the autographic ink, or that kind, which is suitable for transferring on to the stone, the writings, or drawings, which have been executed on paper prepared for that purpose.

This ink ought to be mellow, and somewhat thicker than that used immediately on stone; so that when it is dry on the paper, it may still be sufficiently viscous to cause it to adhere to the stone by simple pressure. The following is the manner of preparing the ink:—

Dry soap,	100	drachms.
White wax, free from tallow,	100	do.
Mutton suet,	30	do.
Shellac,	50	do.
Mastic,	50	do.
Lamp black,	30 to 35	do.

These materials are to be melted in the way we have described for lithographic ink.

Autographic Paper.

The operation by which a writing or drawing is transferred from paper to stone, not only affords the means of abridging labour, but also of producing the writings, or drawings, in the same direction in which they have been traced; whereas when they are executed immediately on stone, they must be performed in a direction opposite to that which they are eventually to have. Thus it is necessary to draw those objects on the left, which, in the impression, are to be on the right hand. To acquire the art of reversing subjects, when writing or drawing, is both difficult and tedious; while, by the aid of transparent, and of autographic paper, impressions may be readily obtained, in the same direction as that in which the writing, or the drawing, has been made.

In order to make a transfer, on to stone, of a writing, a drawing in lithographic ink, or in crayons, or an impression from a copper-plate, it is necessary, 1st, that the drawing, or transcript, should be on a thin and flexible substance, such as common paper; 2d, that it should be capable of being easily detached from this substance, and transferred entirely on to the stone, by means of pressure. But as the ink with which a drawing is traced, penetrates the paper to a certain depth, and adheres to it with considerable tenacity, it would be difficult to detach them perfectly from each other, if, between the paper and the drawing, some substance was not interposed, which, by the portion of water which it is capable of imbibing, should so far lessen their adhesion to each other, that they may be completely separated, in every point. It is to effect this, that the paper is prepared, by covering it with a size, which may be written on with facility, and on which the finest lines may be traced, without blotting the paper. Various means may be found of communicating this property to paper. We will give a preparation which we have always found to succeed, and which, when the operation is performed with the necessary precautions, admits of the finest and most delicate lines being perfectly transferred, without leaving the faintest trace on the paper. For this purpose, it is necessary to take a strong, unsized paper, and to spread over it a size prepared of the following materials:

Starch,	120 drachms.
Gum arabic,	40 do.
Alum,	21 do.

A moderately thick paste is made with the starch, by means of heat; into this paste, is thrown the gum arabic and the alum, which have been previously dissolved in water, and in separate vessels. The whole is mixed well together; and it is applied warm to the sheets of paper, by means of a brush, or a large, flat hair pencil. The paper may be coloured, by adding to the size a decoction of French berries, in the proportion of ten drachms. After having dried this autographic paper, it is put into a press, to flatten the sheets, and they are made smooth, by placing them, two at a time, on a stone, and passing them under the scraper of the lithographic press.

If, on trying this paper, it is found to have a tendency to blot, this inconvenience may be remedied, by rubbing it with finely pounded sardarac. We give below another recipe, which will be found equally useful, and which has the advantage of being applicable to thin paper, which has been sized. It requires only that the paper be of a firm texture.

Gum tragacanth,	4 drachms.
German glue,	4 do.
Spanish white,	8 do.
Starch,	4 do.

The tragacanth is to be put into a large quantity of water, to dissolve, thirty-six hours before it is mixed with the other materials. The glue is to be melted over the fire, in the usual manner. A paste is made with the starch; and after having, whilst warm, mixed these several ingredients, the Spanish white is to be added to

them, and a layer of this sizing is to be spread over the paper, as already described; taking care to agitate the mixture with the brush, to the bottom of the vessel, that the Spanish white may be equally distributed throughout the liquid. We will hereafter point out the manner in which it is necessary to proceed, in order to transfer writings, or drawings.

We must not omit to notice two autographic processes which facilitate, and abridge, this kind of work, when it is desired to copy a *fac simile*, or a drawing in lines. The first of these methods, is to trace, with autographic ink, any subject whatever, on a transparent paper, which is free from grease and from resin, like that which, in commerce, is known by the name of *papier végétal*, and to transfer it to stone; this paper to be covered with a transparent size; this operation is very difficult to execute, and requires much address, in consequence of the great tendency which this paper has to cockle, or wrinkle, when it is wetted. Great facilities will be found from using tissue paper, impregnated with a fine white varnish, and afterwards sized over. In the second process, transparent leaves, formed of gelatin, or fish glue,* are employed, and the design is traced on them, with the dry point, so as to make an incision; these traces are to be filled up with autographic ink, and thence transferred. We will describe, in their proper places, these processes, as well as that of transferring a lithographic, or a copper-plate engraving.

A Notice of a new Engine, possessing great power, now constructing in the vicinity of this city.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—Believing that any information relative to the progress of improvement in the mechanic arts will be acceptable to you, I send you some intelligence respecting a machine which will soon be before the public.

A person residing in the neighbourhood of this city, has nearly completed a small engine, which, in my opinion, will combine safety, simplicity, and economy, in a degree surpassing any of the steam engines now in use; and even those promised in the Franklin Journal of June last. As the engine of which I speak will soon be ready for public inspection, when you will have an opportunity of judging for yourself, I will not now attempt to describe its structure, but merely state some of the advantages which I believe it will present.

It will be free from the heat and the danger which accompany highly elastic steam, as in the engine of Perkins; and from the tremulous motion, and the rumbling noise, produced by that of Brown. It will occupy but little space, probably less than that of Perkins, and is so silent, that it will scarcely be heard. There is no fire, no boiling water, no burning of gas. It is light, simple, and efficient; dissipat-

* The manner of preparing these leaves shall be hereafter given.

ing, at first sight, all those apprehensions which other engines are calculated to excite. It can be regulated so as to work with a pressure of from one to six hundred pounds upon the square inch, with a very moderate strain on any given part of the machinery. The ingenious inventor, whose name will appear in due time, pledges himself, that an engine of sixty horse power shall be kept at work, night and day, for one month, at a cost not exceeding ten dollars.

Before closing, I will state, that the obstacles which existed in Brown's gas engine, have been entirely overcome, as will be made evident to the citizens of Philadelphia, before many weeks are passed; the public therefore might do well to suspend its judgment, respecting this machine, notwithstanding the positive manner in which it has been denounced.

Respectfully, &c.

Joshua Shaw.

Philadelphia, July 10th, 1827.

On the advantages of employing small Cupola Furnaces in Iron-founding. By Thos. Gill, Esq.

In our last volume, page 174, we mentioned that an eminent iron-founder and engineer in London had lately caused a cupola-furnace to be lined to the internal "diameter of *seven inches only* at the basin, although it widened above in a conical form, for the sake of holding more coke."

We have since been highly gratified by the information, that in this small furnace, intended chiefly for small jobs, on a sudden emergency, *they have been able to run down thirty-three hundred weight of cast-iron in a day, and with one half only of the coke usually employed in the larger cupola-furnaces!*

We need hardly add, that they will always continue to employ this small furnace, in preference to a larger, where it will contain a sufficient quantity of iron for their castings; as it not only saves so much fuel, but also melts the iron in a much less time, and consequently with a less expenditure of power to work the bellows.

In plate 2, fig. 6, we have given a figure of this small, hexagonal, cupola-furnace, the outside of which consists of a set of six, nearly similar, cast-iron plates, bound together with screwed hoops of wrought-iron, and lined internally with fire-bricks and road-dust. *It is only five feet in height, but will run down one and a half, or two, hundred weight of cast-iron in half an hour's time.*

It is the intention of this founder, in case of erecting another furnace, to make it a foot, or a foot and a half, higher than the present one. The bellows, are a pair of the larger smiths' bellows, the pipe is two inches internal diameter, and they are worked, rather quick, by means of a crank. There are two circular orifices in the back plate of the furnace, to admit the blast, fully as wide as the bore of

the bellows-pipe, and placed one above the other, in order to use either the one or the other of them, to make the basin more or less deep, according to the quantity of iron to be melted.

[*Technical Repository.*

List of Patents granted in the United States, in February and March, 1827.

FOR INVENTIONS AND IMPROVEMENTS.

In the method of making copperas; Isaac Tyson, Baltimore, February 15.

In the washing machine; Chester Stone, New Haven, Connecticut, Feb. 17.

In a mode of preventing moths, or worms, from destroying hides, skins, furs, and peltry of all kinds; Samuel Storm, New York, Feb. 17.

In the machine for grinding or mixing earth, for making bricks; Benjamin K. Hill, Richmond county, Georgia, Feb. 17.

In the hay, and grain, horse-rake; Moses and Samuel Pennock, Pennsylvania, Feb. 17.

In the machine for pressing cotton, &c.; Philemon White, Chatham county, N. Carolina, Feb. 19.

In the mode of constructing locks, or door fastenings, &c.; John Brown and George W. Robinson, Providence, R. Island, Feb. 20.

In the plough; Ryland Rodes, Charlottesville, Albemarle county, Virginia, Feb. 20.

In the percussion gun-lock, for rifles, &c.; William A. Hart, Fredonia, N. York, Feb. 20.

In making salt; Benajah Byington, Salina, New York, Feb. 21.

In the art of building and constructing ships, &c.; Thomas W. Bakewell, Cincinnati, Ohio, Feb. 21.

In the machine for clearing grounds of logs and brush; Squire Collins, Hillsdale, Columbia county, New York, Feb. 22.

In the art of inlaying gold or any other metal, in turtle or tortoise-shell and horn, for various ornamental and fancy articles; Uriah Bailey, Massachusetts, Feb. 22.

In manufacturing andirons; Edward Smylie, New York, Feb. 22.

In the manufacture of suspenders; A. L. Van Horn, Philadelphia, Feb. 22.

In the pump, used for steam-boilers; Alfred Judson, New York, Feb. 23.

In bedsteads; Chester Johnson, New York, Feb. 24.

In the bee-hive; C. Wiggins, Pennsylvania, Feb. 27.

In the grist mill; Benjamin Overman, N. Carolina, Feb. 28.

In finishing paper; Ira White, and Leonard Gale, Vermont, Feb. 28.

In cutting garments; James G. Wilson, New York, Feb. 28.

In propelling boats; E. Fuller, R. Island, March 2.

In the mode of blowing and striking for blacksmiths; L. Hoyt, and E. Pierce, New York, March 3.

In laying ropes, called the combined jacks, rope layer, and breast-work; David Myerle, Philadelphia, March 3.

In making watch seals; S. Davis, H. P. Babbitt, and B. B. Grinnell, Providence, Rhode Island, March 3.

In making shovels; Oliver Ames, Massachusetts, March 5.

In the machine for turning tenons; John W. Sweet and William Stedman, Massachusetts, March 5.

In the machine for grinding apples; H. E. Paine and S. H. Russel, Ohio, March 5.

In bridges; William Woodmansee, New York, March 6.

In the machine for shearing cloth; James Collins, Maine, March 6.

In the water wheel for saw-mills; Thomas Shute, Tennessee, March 6.

In a machine for cutting metallic and other hard substances; John H. Hall, Virginia, March 7.

In the spring hammer, for blacksmiths; James Rainey, North Carolina, March 7.

In a composition of matter with which marbles, granites, and stones of all descriptions are perfectly imitated; Louis Matthy, New York, March 7.

In inserting, or ingrafting, teeth; E. A. Bigelow, Vermont, March 8.

In spur or bevel gearing for mills, &c. Charles Neer, Waterford, Saratoga county, New York, March 9.

In crank and wheel dampers for chimneys; James Reilly, and John Flanagan, Waynesburg, Franklin county, Penn., March 10.

In the horizontal wind mill; Jonathan Reynolds, America, Dutchess county, N. York, March 15.

In the machine for cutting straw, &c. Calvin Chamberlin, America, Dutchess county, N. York, March 15.

In the manufacture of hatter's cards or jacks; Joseph C. Seely, Dutchess county, N. York, March 15.

In the mode of constructing the feet of brass andirons, &c.; John Griffiths, N. York, March 15.

In an instrument called the wheelwright's assistant for turning and boring hubs, &c.; Cyrus W. Beach, Schoharie, N. York, March 16.

In shelling corn; George E. Waring, Westchester county, N. York, March 16.

In extracting alcohol from common proof spirits, by the use of steam; A. Wolcott, and N. Wolcott, Bloomfield, Ontario county, N. York, March 19.

In a spring temple, for looms; A. Jenks, and J. Clewell, Holmesburg, near Philadelphia, March 19.

In the grist mill crusher and sheller; John G. Morse, Randolph county, N. C. March 20.

In the machine for making bricks; David Rising, Alchester, Vermont, March 21.

NOTICES.

Franklin Institute Exhibition.

Manufacturers, and others, who propose to send articles to the next annual exhibition, are reminded, that they may be deposited at the Hall of the Institute, at any time, between the 1st of August, and 1st day of October.

Much inconvenience has heretofore resulted from the late arrival of goods; it is hoped, therefore, that exhibiters will be prompt in sending, as it will otherwise be impossible so to arrange the different articles, as to display them to the most advantage. The exhibition will open on Wednesday, the 3d day of October.

It is requested that those who exhibit articles, will affix their names to them; and such as are for sale, should have in addition, their price, and the residence of the vender.

Further information may be obtained, on applying by letter, *post paid*, to either of the members of the committee of arrangement, which consists of the following gentlemen—James Ronaldson, Adam Ramage, Thomas Fletcher, A. G. Ralston, Abraham Miller, Samuel J. Robbins.

Micaceous Sand, or decomposed Mica, and Fire-bricks.

Colonel Robert Carr, at the Botanic garden, near the lower ferry, on the banks of the Schuylkill, has discovered, upon his grounds, extensive beds of this article: from its abundance, and its vicinity to the river, he will be able to deliver it at any of the wharves on the Schuylkill, at about half the price at which it has heretofore been furnished.

We are credibly informed that fire-brick has been made here, by the aid of this article, in every respect equal to the best Stourbridge bricks; such certainly is not usually the case, and the brick-maker who should succeed, in producing, uniformly, such an article, might secure a very lucrative business.

A very good fire-brick, is made in Baltimore, from earth dug up on the basin, in the immediate vicinity of the iron foundries. We are assured that these bricks are superior to the imported, and we have *seen* reason to credit the assurance. We have by us, a specimen of the brick, and of the earth from which it is made.

To Postmasters.

Postmasters, at whose offices numbers of this Journal may remain unclaimed, are particularly requested to return them to Mr. Dobson, the publisher.

To Subscribers.

The few who have paid, or forwarded, their subscription for the present year, have the thanks of the publisher; the many from whom it is due, he hopes will soon elicit his gratitude.